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CHAPTER PRESIDENTS AND SECRETARIES

ALBANY—**Basil Y. Scott,** *2 Summit St., Rensselaer, New York*; **Cynthia M. Pense,** *42 Herrick Avenue, Delmar, New York*

AUSTIN—**Richard C. Henshaw, Jr.,** *3409 Cedar Street, Austin 5, Texas*; **Stella Traweek,** *W.H. 221 University Station, Austin 12, Texas*

BOSTON—**John G. Booton,** *267 Beacon Street, Boston 16, Mass.* **John E. Alman,** *Office of Statistical Service, Boston University, 725 Commonwealth Avenue, Boston 15, Mass.*

BUFFALO-NIAGARA—**Robert H. Matthias,** *20 Ward Park Road, Grand Island, New York*; **Sigmund Zobel,** *16 Addison Street, Eggertsville 21, New York*

CENTRAL INDIANA—**Donald L. Cheak,** *5432 East 19th Street, Indianapolis, Indiana*; **Richard W. Graves,** *2127 E. 27th, Bloomington, Indiana*

CENTRAL NEW JERSEY—**Martin B. Wilk,** *Bell Telephone Laboratories, Inc., Room 2D-535, Murray Hill, New Jersey*; **Norman Frederiksen,** *Educational Testing Service, Princeton, New Jersey.*

CHICAGO—**Rudolf T. Ericson,** *4142 Howard Avenue, Western Springs, Illinois*; **Donald Parise,** *The Chicago Tribune, 435 N. Michigan Ave., Chicago, Illinois*

CINCINNATI—**Harry Smith, Jr.,** *124 Hosea, Cincinnati 20, Ohio*; **Arthur E. Hinman,** *Dept. of Sociology, University of Cincinnati, Cincinnati 21, Ohio*

CLEVELAND—**David Frazier,** *Research Div., Standard Oil Company of Ohio, 2127 Cornell Road, Cleveland 6, Ohio.* **Charles H. Joseph, Jr.,** *American Greetings Corp., 1300 W. 78th Street, Cleveland, Ohio*

COLUMBUS—**Melvin C. Koch,** *Battelle Memorial Institute, 505 King Avenue, Columbus 1, Ohio*; **Mikhail V. Condoide,** *188 West 10th Avenue, Columbus 1, Ohio*

CONNECTICUT—**Colin White,** *81 Russell Street, Hamden, Connecticut*; **Royal A. Crystal,** *Manager, Statistical Dept., Connecticut Medical Service, Inc., P.O. Box 1930, New Haven, Connecticut*

DAYTON—**Richard E. Biedenbender,** *208 Young Street, Middletown, Ohio*; **John E. Condon,** *2813 Nacoma Place, Dayton 10, Ohio*

DENVER—**Edwin L. Crow,** Boulder *Laboratories, National Bureau of Standards, Boulder, Colorado*; **Harriet E. Little,** *Blue Cross, Blue Shield Plans, 1653 Laurence Street, Denver 2, Colorado*

DETROIT—**T. J. Obal,** *Ford Motor Company, Central Office Bldg. The American Road, Dearborn, Michigan*; **Hugh Brown,** *Business Research Section, General Motors Corporation, Detroit 2, Michigan*

HAWAII—**Charles F. Congdon,** *College of Business Adm., University of Hawaii, Honolulu, Hawaii.* **Louisa Franzen,** *267-A Portlock Road, Honolulu 16, Hawaii*

UNIV. OF ILLINOIS—**Donald L. Burkholder,** *Dept. of Mathematics, University of Illinois, Urbana, Illinois*; **Frederick William,** *109 West Pennsylvania, Urbana, Illinois*

ITHACA—**C. R. Henderson,** *Department of Husbandry, Cornell University, Ithaca, New York*; **Philip J. McCarthy,** *New York State School of Industrial & Labor Relations, Cornell Univ., Ithaca, N. Y.*

MILWAUKEE—**J. Raymond Helbert,** *Red Star Yeast and Products Co., 325 N. 27th Street, Milwaukee 8, Wisconsin*; **Norman J. Kaye,** *College of Business Adm., Marquette University, Milwaukee 3, Wisconsin*

MONTREAL—**Charles S. Carter,** *Bell Telephone Company of Canada, 1050 Beaver Hall Hill, Montreal, Quebec, Canada*; **Jacques Saint Pierre,** *Professor of Statistics, University of Montreal, Quebec, Canada*

NEW ORLEANS—**Roland Pertuit,** *4871 Metropolitan Drive, New Orleans, Louisiana*; **Elsie M. Watters,** *School of Business Administration, Tulane University, New Orleans, Louisiana*

NEW YORK—**Douglas Greenwald,** *McGraw-Hill, 330 West 42nd Street New York 36, New York*; **Sidney Sameth,** *Union Health Center, 275 7th Avenue, New York, New York*

NORTH CAROLINA—**Gertrude M. Cox,** *Institute of Statistics, Box 5457, State College Station, Raleigh, North Carolina*; **Robert J. Monroe,** *Box 5457, State College Station, Raleigh, North Carolina*

NORTH TEXAS — **Paul D. Minton,** *Mathematics Dept., Southern Methodist University, Dallas, Texas*; **Mary P. Moseley,** *3428 McFarlin Boulevard, Dallas 5, Texas*

OKLAHOMA CITY—**Francis R. Cella,** *Director, Bureau of Business Research, College of Business Adm., University of Oklahoma, Norman, Oklahoma*; **Ellen L. Bryan,** *2505 Northwest 31st Street, Oklahoma City, Oklahoma*

PHILADELPHIA—**Haym Jaffe,** *806 Brighton Street, Philadelphia 11, Pennsylvania*; **John H. Norton,** *Statistics Dept., Dietrich Hall, University of Pennsylvania, Philadelphia 4, Pennsylvania.*

PITTSBURGH—**Irwin Miller,** *United States Steel Corp., Applied Research Laboratory, Monroeville, Pennsylvania*; **Isidore Altman,** *Graduate School of Public Health, University of Pittsburgh, Pittsburgh 13, Pennsylvania*

PUERTO RICO—**Juan Gonzales Ramos,** *Puerto Rico Planning Board, Santurce, Puerto Rico*; **Carmen Alcaraz,** *Puerto Rico Economic Association, Santurce Building, 4th Floor, Santurce, Puerto Rico*

ROCHESTER, N. Y.—**Jack Karger,** *210 East Hickory Street, East Rochester, New York*; **Robert O. Welk,** *Statistical Dept., Eastman Kodak Company, 343 State Street, Rochester 4, New York*

SACRAMENTO—**H. Arthur Domonoske,** *5540 Spillman Avenue, Sacramento, California*; **Ann C. Welch,** *921 45th Street, Sacramento 19, California*

SAN FRANCISCO—**Phillis Beattie,** *U. S. Bureau of Labor Statistics, 630 Sansome Street, Room 802, San Francisco 11, California*; **Charles Roumassett,** *Bureau of Labor Statistics 630 Sansome Street, San Francisco 11, California*

ST. LOUIS—**Donald E. Paul,** *c/o Laclede Gas Co., 1017 Olive Street, St. Louis 1, Missouri*; **Edward G. Kreyling, Jr.,** *St. Louis-San Francisco Railway Co., 906 Olive Street, St. Louis 1, Missouri*

SOUTHERN CALIFORNIA—**John A. Scott,** *1417 Oak Street, Santa Monica, Calif*; **Charles I. Landenberger,** *965 Coronado Drive, Glendale 6, Calif.*

STATE COLLEGE, PA.—**Hans A. Panofsky,** *Professor of Meteorology, Pennsylvania State University, University Park, Pennsylvania*; **William S. Ray,** *Associate Prof. of Psychology, Pennsylvania State University, University Park, Pennsylvania*

TULSA—**Lyndral E. Marcum,** *Blue Cross Blue Shield Hospital & Physician Service, P.O. Box 1738, Tulsa, Oklahoma*; **Marshall E. Milligan,** *Stanolind Oil and Gas Co., Tulsa, Oklahoma*

TWIN CITIES, MINN.—**John Neter,** *School of Business Adm., University of Minnesota, Minneapolis 14, Minnesota*; **Gordon K. Johnson,** *Aero Division, Minneapolis Honeywell, Minneapolis, Minn.*

VIRGINIA—**Norbert L. Enrick,** *c/o Institute of Technology, Charlottesville, Virginia*; **Ralph A. Bradley,** *Dept. of Statistics, Va. Polytechnic Institute, Blacksburg, Virginia*

WASHINGTON, D. C.—**Margaret E. Martin,** *Office of Statistical Standards, Bureau of the Budget, Washington 25, D. C.*; **Edwin D. Goldfield,** *Chief, Statistical Reports Division, Bureau of The Census, Washington 25, D. C.*

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The Editorial Committee welcomes the submission of manuscripts for possible publication. Two copies, double-spaced, should be sent to the Editor, Morris Hamburg, E-230 Dietrich Hall University of Pennsylvania, Philadelphia 4.

News and notes should be sent to Dana Barbour, News Editor, American Statistical Association, 1757 K Street, N.W., Washington 6, D. C.

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Anyone wishing to change his mailing address should allow eight weeks notice. A copy of the address taken from an issue of the periodical should accompany the change-of-address request.

RESULTS OF ASA ELECTION

The following new officers were elected in the mail balloting last fall:

President-Elect
Rensis Likert, Institute for Social Research, University of Michigan

Vice-President (1958-60)
Howard L. Jones, Illinois Bell Telephone Company

Directors (1958-60)
Ralph Burgess, American Cyanamid Company
Oscar Kempthorne, Iowa State College

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Philip J. McCarthy, Cornell University

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District No. 4
Irwin Friend, University of Pennsylvania, Philadelphia, Pennsylvania

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Emmett Welch, Public Works Planning Unit, Washington, D. C.

District No. 6
A. L. Finkner, University of North Carolina, Raleigh, North Carolina

District No. 7
Arthur S. Littell, Western Reserve University, Cleveland, Ohio

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Wesley D. Mitchell, Peoples Gas Light & Coke Co., Chicago, Illinois

District No. 9
Albert W. Wortham, Texas Instruments Company, Dallas, Texas

District No. 10
John C. McKee, Douglas Aircraft Company, Los Angeles, California

At the Board and Council meeting of January 17th, Herbert Marks, Metropolitan Life Insurance Company, New York City, was elected to fill the unexpired term of Ralph Burgess as representative from the 3rd District.

(For the composition of these districts see map and listing elsewhere in this issue.)

The complete list of officers, including the continuing officers as well as those newly-elected, is printed in the adjoining column of this page.

NEWS

1958 MEETING PLANS — LIAISON EDITORS AND SECTION OFFICERS ANNOUNCED — NEW NBER REPORTS — CHICAGO CHAPTER MIDWEST CONFERENCE — MEETINGS, COURSES, OPENINGS

Plans for 1958 Annual Meeting

Out in Chicago the wheels are beginning to turn in preparation for the Annual Meeting to be held December 27-30, 1958. Several allied social science associations, including the American Economic Association, the American Finance Association, the American Marketing Association, the American Association of University Teachers of Insurance, the Biometric Society (ENAR), the Econometric Society, the Industrial Relations Research Association, the Institute of Mathematical Statistics, and the Regional Science Association, have already scheduled meetings in Chicago during Christmas week. ASA headquarters will be at the Congress Hotel, just outside the Loop.

Ralph E. Burgess, Program Chairman, reports plans for a number of joint ASA sectional sessions and inter-association sessions as well as luncheon meetings and the evening session for the Presidential address.

The Program Committee still solicits any papers or suggestions for session subjects. These should be submitted not later than March 1, 1958. Brief abstracts (up to 200 words) of papers should be sent either to Ralph Burgess, American Cyanamid Company, 30 Rockefeller Plaza, New York 20, New York or to the appropriate Section representative on the Program Committee. These are:

Biometric Section:
Virgil L. Anderson
Statistical Laboratory
Purdue University
Lafayette Indiana

Business and Economic Statistics Section:
George Garvy
Federal Reserve Bank
33 Liberty Street
New York 45, New York

Section on Physical and Engineering Sciences:
Ralph H. Bacon
General Precision Laboratory
Pleasantville, New York

Social Statistics Section:
William Hodgkinson, Jr.
American Telephone and Telegraph Company
195 Broadway
New York, New York

Section on Training:
Bernard G. Greenberg
School of Public Health
University of North Carolina
Chapel Hill, North Carolina

Plans are to print, in advance, abstracts of the papers to be presented at the Annual Meeting and to sell them with the program at the time of registration.

Omer Miller of the Chicago Chapter will head the Local Arrangements Committee. Mr. Miller's address is Illinois Bell Telephone Company, 212 West Washington Street, Chicago 6, Illinois.

Section Liaison Editors for ASA *Journal*

All of the Sections of the Association have now designated members to serve as liaison representatives to the Editor of the *Journal*. This action, which was noted in the October issue of *The American Statistician*, was decided upon by the Board and Council as a means of facilitating a broad and balanced publication program serving the wide interests of Association members. These liaison editors are:

Biometrics—Jerome Cornfield, National Institutes of Health, Bethesda, Maryland

Business and Economic Statistics—Frank Garfield, Federal Reserve Board, Washington, D. C.

Physical and Engineering Sciences—Irving Burr, Purdue University, Lafayette, Indiana

Social Statistics—Herbert Solomon, Columbia University, New York City

Training of Statisticians—John E. Freund, Arizona State College, Tempe, Arizona

Sections Elect Officers

The following new officers were elected by the *Biometric Section* as a result of the mail balloting last fall:

Chairman-Elect — Marvin Schneiderman, National Cancer Institute, U. S. Public Health Service

Executive Committee—Mavis Carroll, General Foods Corp.; Calvin Zippin, University of San Francisco Medical School

The other officers of the Section are Henry Tucker, Chairman, Clyde Y. Kramer, Secretary, and the following members of the Executive Committee: Ralph A. Bradley, Irwin D. J. Bross, Glenn L. Burrows and Bernard G. Greenberg.

The *Business and Economic Statistics Section* elected the following:

Chairman-Elect—William H. Shaw, E. I. du Pont de Nemours & Co.

Program Chairman-Elect—David C. Melnicoff, Pennsylvania Railroad Company

Regional Activities Chairman—Kenneth E. Miller, Armour & Company

Publications Chairman—James W. Knowles, Joint Committee on the Economic Report, U. S. Congress

Secretary-Treasurer—Kenneth M. Wright, Life Insurance Association of America

Officers continuing in office are Roy L. Reierson, Chairman, and George Garvy, Program Chairman.

The *Section on Physical and Engineering Sciences* chose as Chairman-Elect, Cuthbert Daniel, Consulting Engineering Statistician. James L. Dolby, General Electric Company, was reelected Secretary. Continuing in office are Irving Burr, formerly Chairman-Elect and now Chairman, and the following members of the Executive Committee: Robert Bechhofer, Carl A. Bennett, William R. Pabst, Jr., and Harold F. Weaver.

New Officers of the *Social Statistics Section* are:

Chairman-Elect—Walt R. Simmons, Public Health Service

Vice-Chairman—Daniel O. Price, University of North Carolina

Secretary—William Hodgkinson, Jr., American Telephone & Telegraph Company

Other officers are Dudley Kirk, Chairman, and Chester Rapkin, Vice-Chairman.

Officers of the *Section on Training* were elected at the Annual Meeting in September 1957 and were reported in the October issue of *The American Statistician.*

News of the Section on Training

The Section on Training is making excellent progress this year. There will be five section meetings at the Chicago meeting of the American Statistical Association. The Program Chairman for the Training Section is Dr. B. G. Greenberg, Chairman-Elect of the Section, who would welcome papers and suggestions for the meeting. A study has been made on the matter of training aids for the teaching of statistics. Dr. Leslie Kish started a movement to get the Sigma Xi to name a statistician to their national lecture program.

NBER Report on Federal Lending

A summary of a comprehensive study on Federal Lending and Loan Insurance published in book form in January 1958 was released by the National Bureau of Economic Research in December 1957 as an occasional paper. The title of the summary report is "Federal Lending: Its Growth and Impact." The study, which was begun six years ago, was made by Professor R. J. Saulnier of Columbia University and the National Bureau (now Chairman of the President's Council of Economic Advisers), Harold Halcrow of the University of Illinois, and Neil H. Jacoby of the University of California at Los Angeles (currently on leave as U. S. representative in the Economic and Social Council of the United Nations). The period covered is from 1917, the start of Federal lending, through 1953. The study includes not only the direct agencies of the Federal Government, but also sponsored agencies such as the Federal Land Banks and Federal Home Loan Banks. Credit aids to businesses, farmers, and other individuals, and to state and local governments are included.

The report points out that the growth of Federal loan, loan insurance and guarantee programs has been so great that they now constitute a second financial system, partly competing with and partly complementing the private financial system. From 1950 through 1953, Federal lending and loan underwriting averaged about $13 billion a year—over five times the average for 1935-39. As of December 1953, outstanding Federal commitments under insurance and guarantee contracts totaled nearly $30 billion, mainly on urban mortgages, while direct loans outstanding were over $13 billion, mainly in agricultural and business financing. In recent years, the emphasis has been on Federal insurance or guarantees of loans made by private institutions, rather than on direct loans.

The importance of Federal credit aids varies for different major sectors of the economy. In agriculture, Federal or Federally-sponsored agencies held 19 percent of the mortgage debt outstanding at the end of 1953. They also held 28 percent of the short-term debt, with another 28 percent under Commodity Credit Corporation guarantee. In urban housing, loans protected by FHA insurance or VA guarantee represented 27 percent of the dollar total of home mortgages of $20,000 or under that were recorded during 1953. Federal credit aid to business concerns was not much below the total outstanding for agriculture, but was small compared to financing supplied by private institutions and individuals. Aid to state and local governments was small, both as a part of Federal credit and in comparison with the amounts supplied by private sources.

The authors found that most of the Federal credit programs have been self-supporting, at least from the long-range point of view. An element of subsidy has been present only in those programs which served a particular class of borrower, such as low-income farmers, veterans or small business firms.

The most difficult part of the inquiry was to trace the economic effects of these huge and diverse credit operations. Their influence on business cycles has been mixed, but on balance the authors conclude the programs have operated more often than not to offset a contracting or depressed level of economic activity, and to stimulate the economy in the early stages of a recovery movement. In agriculture, by increasing the supply and decreasing the cost of credit, Federal programs probably resulted in a larger allocation of resources to farms than would otherwise have been the case, thereby increasing the supply of agricultural products. Because of its relatively small role in business Federal credit has probably not had much direct effect on production and employment. The most important effects have probably been institutional, consisting of profound and enduring changes in the operations and functions of the private financial system.

"Federal Lending: Its Growth and Impact," Occasional Paper 58, may be obtained from the National Bureau of Economic Research, Inc., 261 Madison Ave., New York 16, at a price of $1.00 a copy.

NBER Report on Electronic Computers and Business Indicators

The National Bureau of Economic Research published in December its first report on a long-term project to study the application of electronic computers to economic statistics. This report is "Electronic Computers and Business Indicators," by Julius Shiskin. A second, more technical report, "Seasonal Adjustments by Electronic Computer Methods," by Julius Shiskin and Harry Eisenpress, appeared in the December 1957 issue of the ASA *JOURNAL*. The project is under the direction of Geoffrey Moore, Associate Director of Research, and Julius Shiskin, Research Associate at the Bureau in 1956-57. Mr. Shiskin, who was on leave from the Bureau of the Census when the report was prepared, received a Rockefeller Public Service Award for 1956-57 to continue the exploration and testing of computer techniques which he began at the Census Bureau.

The present report is being published by the National Bureau as Occasional Paper 57 and has also been published in the October issue of the *Journal of Business*. It is concerned with the use of electronic computers to separate the more meaningful business trends from seasonal and irregular fluctuations. Knowledge of cyclical movements is of critical importance at the points at which activity is beginning to rise or fall. The device of making comparisons with the same month a year ago is frequently used, but has a number of serious drawbacks which Mr. Shiskin points out. For one thing, such comparisons often do not indicate correctly the trend during the preceding six months, which may be crucial in current business analyses.

An electronic computer program has been developed and tested which makes adjustments for differences in the number of working or trading days where needed for monthly comparisons, eliminates seasonal variations, irons out irregular fluctuations, and shows cyclical movements. This program can be applied to any kind of time series—the sales of a particular company as well as important economic indicators. Mr. Shiskin describes the methods used in adjusting for seasonal variations (an improved version of the ratio-to-moving-average method), and taking care of irregular fluctuations. Various summary measures are also computed, including ratios of the average amplitudes of the irregular to the cyclical factors for one-month, two-month, three-month and longer periods; an index of the months required for cyclical dominance; and the average number of consecutive monthly changes in the same direction (average duration of run). These measures have been computed for hundreds of series and are shown in this report for 18 important economic indicators.

These methods, according to the author, appear to offer a workable solution to the problem of making more irregular series like business failures and retail sales show their cyclical movements as clearly as those for factory employment and industrial production. They require, however, a vast amount of computation. The electronic computers can make in seconds computations that would require weeks of clerical work. With high-speed printers, the resulting figures are not only printed but are also charted as visual aids to interpretation. Most Federal statistical agencies are already making some use of the program, as are some private research groups and business organizations.

Mr. Shiskin provides evidence to show that the electronic computer methods yield at least as good results as the best hand methods, but also recognizes limitations in the present program, and emphasizes the need for further improvements. He believes that the present program "provides only a glimpse of what can be accomplished . . . It is to be hoped that the application of fresh young minds, not shackled to the methods of the past, will bring a modification of this program beyond recognition and, perhaps more important, the development of completely new and more fruitful approaches to the analysis of economic problems."

The report includes appendices which show in considerable detail computational steps for the different adjustments together with sample tables, and basic data and sources for the 18 economic indicators. It is available from the National Bureau of Economic Research, 261 Madison Avenue, New York 16, at $1.00 per copy.

Fifth Annual Midwest Statistical Conference

The Chicago Chapter of the American Statistical Association in cooperation with the Chicago Association of Commerce and Industry is sponsoring the 5th Annual Midwest Statistical Conference on Saturday, March 15, 1958. The conference will be held in the Congress Hotel.

The theme of the conference is "Statistical Techniques Utilized in Forecasting and Planning Economic Expansion of Metropolitan Areas." The morning session is to be devoted to three general sessions in which the measurement of population requirements (including labor force), capital and land facility requirements will be discussed. The afternoon session will be devoted to a series of workshops, during which time particular applications of some of the techniques discussed in the morning session will be covered. Academic, business, industry, and statisticians for public agencies are invited.

Further information about the conference may be obtained from Lawrence V. Conway, American Savings and Loan Institute, 221 North LaSalle St., Chicago 1.

Cooperative Training Program in Biostatistics

The Virginia Polytechnic Institute, Blacksburg, and the Medical College of Virginia, Richmond, have initiated a cooperative graduate training program in biostatistics through a grant from the National Institutes of Health.

This program utilizes the facilities of both institutions for meeting the critical demand for statisticians in the medical and public health professions. It is proposed to train both M.S. and Ph.D. candidates as well as to give post doctorate training in the field of statistics to holders of Ph.D. degrees in related fields.

Most of the course work will be given at the Virginia Polytechnic Institute, but certain specific courses relating to medical and public health statistics will be taken by the candidates at the Medical College of Virginia in Richmond. It is expected that in general a doctoral candidate will spend one year of his graduate study at the Medical College of Virginia.

To carry on this program, a staff of nine in the Department of Statistics at the Virginia Polytechnic Institute is being increased by one professor specifically in biostatistics, and the Medical College is adding a professor of biostatistics who will supervise the work in statistics at that division. The fellowships for candidates for graduate degrees at the Virginia Polytechnic Institute are being increased considerably in number as well as in amounts to take care of this new field of study in biostatistics. In addition to these fellowships, post doctorate fellowships are available for students in biology, medicine, and other related fields who wish to study statistics.

Information about the program in biostatistics, including fellowships, should be requested from Boyd Harshbarger, Head, Department of Statistics, Virginia Polytechnic Institute, Blacksburg, Virginia.

Southern Regional Graduate Summer Session in Statistics

The fifth Southern Regional Graduate Summer Session in Statistics will be held June 16 through July 26, 1958, at Oklahoma State University, Stillwater, Oklahoma. The summer sessions are rotated annually among the following institutions: Virginia Polytechnic Institute, Oklahoma State University, University of Florida and North Carolina State College. They are designed to carry out a recommendation of the Southern Regional Education Board's Committee on Statistics, on which the four institutions initiating the program are represented.

The program may be entered at any session, and consecutive courses will be offered in successive summers. The summer work in statistics may be applied towards residence requirements at any one of the cooperating institutions, as well as certain other institutions, in partial fulfillment of residence requirements for graduate degrees. Each annual summer session lasts six weeks and the several courses offered carry three semester hours of graduate credit.

The sessions will be of particular interest to (1) research and professional workers who want intensive instruction in basic statistical concepts and who wish to learn modern statistical methodology, (2) teachers of elementary statistics courses who want some formal training in modern statistics, (3) prospective candidates for graduate degrees in statistics, (4) graduate students in other fields who desire supporting work in statistics, and (5) professional statisticians who wish to keep informed of advanced specialized theory and methods.

The faculty for the 1958 Summer Session at Oklahoma State University will include the following visiting professors: H. O. Hartley, Statistical Laboratory, Iowa State College; Walter T. Federer, Biometrics Unit, Cornell University; John E. Freund, Department of Mathematics, Arizona State College; A. W. Wortham, Operations Research Department, Texas Instruments, Dallas, Texas. The local staff includes: Carl E. Marshall (Ph.D., Iowa State), Franklin Graybill (Ph.D., Iowa State), Robert D. Morrison (Ph.D., North Carolina State), John Hamblen (Ph.D., Purdue), Roy Deal (Ph.D., University of Oklahoma), and John Hoffman (Ph.D., University of Oklahoma).

Of particular interest at this summer session will be the six weekly symposia covering six important areas in statistics. They are: Sampling Survey Designs, Experimental Designs, Non-parametric Statistics, Response Curves and Surfaces, Multiple Comparisons, and High Speed Computing. Discussants will be selected from major contributors to these areas. These invited speakers together with the outstanding summer school staff will cover the respective subjects from three points of view: applications, their mathematical bases, and the problems that lie on the frontier.

Inquiries should be addressed to Carl E. Marshall, Director, Statistical Laboratory, Oklahoma State University, Stillwater, Oklahoma.

Pennsylvania Interdepartmental Committee on Statistics

During 1955 and 1956 a number of committees composed of representatives from statistical agencies in the Commonwealth of Pennsylvania and from interested nongovernmental organizations reviewed statistical releases prepared by Commonwealth agencies and made a series of recommendations for improving the State statistical programs. During 1957 an informal coordinating group under the auspices of the Director of Program Evaluation in the Governor's Office has met approximately once a month. Departments represented on the committee include Agriculture, Health, Internal Affairs, Labor and Industry, Mines, State Planning Board, Public Instruction, Public Assistance, Revenue, and Welfare.

Committee members have exchanged information on current and proposed statistical programs. Subcommittees on uniform style, standards for the publication of State statistical data, expediting the publication of State statistical releases, and State population estimates have been active.

A statement of standards for the publication of State statistical data was accepted unanimously by the coordinating committee and has been used as the basis for evaluating new statistical releases prepared by the Board of Parole, the Department of Health, and the Department of Welfare. The statement of standards is patterned after a similar statement issued in 1952 for Federal use by the Office of Statistical Standards in the Bureau of the Budget.

The committee on population estimates has reviewed the methodology for county population estimates used by the State Planning Board. Mr. Benjamin Greenberg of the Estimates and Forecasts Section of the Population Division of the Bureau of the Census spoke to the group about the role of the Bureau of the Census in preparing population estimates.

The coordinating group has cooperated with the Bureau of Statistics in the Department of Internal Affairs in planning for a Statistical Abstract of Pennsylvania to be published in 1958.

The current plans of the coordinating group include the possibility of preparing an inventory of social and economic research being undertaken by Commonwealth of Pennsylvania agencies, and a review of the format being used in State statistical releases.

Army Symposium on Numerical Approximation

A Symposium on Numerical Approximation sponsored by the Mathematics Research Center, U. S. Army, will be held April 20 to 23 at the University of Wisconsin, Madison. The topics of the Symposium include linear approximation, interpolation, Tchebycheff and other extremal approximations, expansions and algorithms.

One-hour surveys (including a survey of recent Russian literature) and 30-minute research papers will be presented. There will be opportunity for formal and informal discussion. It is intended to have the proceedings of the Symposium published.

Approximately twenty speakers will participate. Among these are the following guests from abroad: L. Collatz, L. Fox, Z. Kopal, C. P. Miller, A. Ostrowski and E. L. Stiefel.

Workers in the field interested in attending the Symposium should write to

Professor R. E. Langer, Director
Mathematics Research Center, U. S. Army
University of Wisconsin
1118 W. Johnson Street
Madison 6, Wisconsin

Public Health Traineeships

The Public Health Service, U. S. Department of Health, Education and Welfare, has established a program of traineeships designed to bring new people into the field of public health through providing postgraduate public health training opportunities for men and women who have completed their basic professional education. Qualified persons who may be interested in the field of public health statistics are eligible to receive these grants.

Stipends range from $250 to $400 a month, depending on the academic degree held by the individual, plus additional allowances for dependents, travel of the trainee, and academic tuition and fees. A fellow may select the educational institution of his choice which offers a nationally recognized graduate or specialized public health training program in his professional field. Traineeships are awarded for a period not to exceed twelve months and will vary with requirements of different training institutions.

Applications for traineeships to begin in the fall semester should be submitted by March 1, 1958. Additional information and application forms may be secured from any of the Regional Medical Directors of the Public Health Service, or from the Chief, Division of General Health Services, Bureau of State Services, Public Health Service, Department of Health, Education and Welfare, Washington 25, D. C.

Job Opening

The Office of The Surgeon General, Department of the Army, has a vacancy for an Analytical Statistician (health and medicine), GS-7, $4525 per annum. Applicants must have experience in moderately difficult analytical statistical research which included the appraisal of the quality and adequacy of statistical sources of data, assistance in the selection and use of appropriate technical statistical methods, and the interpretation of calculated statistical measures. One year of experience must be in the subject matter field of health and medicine.

Study in an accredited college or university may be substituted for the required experience at the rate of 1 year of college study for 1 year of experience to a maximum of 4 years, provided a sufficient amount of statistical studies have been undertaken.

More details may be obtained by writing:

Civilian Personnel Office
Office of The Surgeon General
Department of the Army
Washington 25, D. C.

ASA Districts

In accordance with the decision of the ASA Board and Council, a map and listing of the present districts of the Association is being reprinted in this issue. It will be recalled that the decision to redistrict the Association on a geographical basis was made at the September 1956 meeting of the Board and Council in order to provide better representation and insure that members not in chapter areas would also have a vote for representatives from

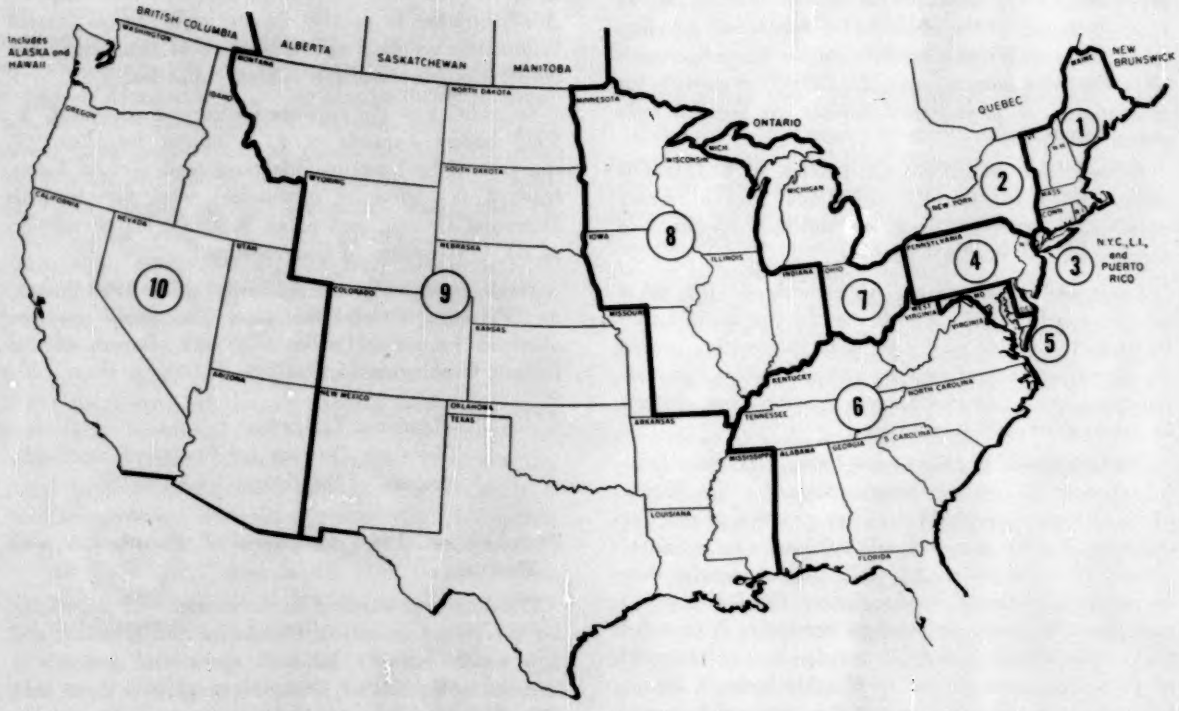
their areas. The plan was to be tried for two years and then re-examined by the council.

The districts, their geographical areas, and the chapters included in each are as follows:

1. New England States (except members of New York City Chapter) (Chapters: Connecticut, Boston);
2. New York State (except New York City and members of that chapter), Ontario, Quebec, Maritime Provinces (Chapters: Buffalo-Niagara, Albany, Ithaca, Rochester, Montreal);
3. New York City, including members of the chapter living in the metropolitan and commuting areas, and Puerto Rico;
4. New Jersey (except members of New York City Chapter), Pennsylvania, Delaware (and Eastern Shores) (Chapters: Central New Jersey, Philadelphia, Pittsburgh, State College, Pa.);
5. Maryland, District of Columbia, metropolitan and commuting areas of Washington, D. C. in Northern Virginia (Chapters: Washington, D. C.);
6. Virginia (except as in 5), West Virginia, Kentucky, North Carolina, Tennessee, South Carolina, Georgia, Alabama, Florida (Chapters: Virginia, North Carolina);
7. Ohio, Michigan (Chapters: Detroit, Cleveland, Columbus, Dayton);
8. Indiana, Illinois, Wisconsin, Minnesota, Iowa, the eastern part of Missouri (Chapters: Central Indiana, Chicago, Urbana, Ill., Milwaukee, Twin Cities (Minn.), St. Louis);
9. Alberta, Manitoba, Saskatchewan, North Dakota, Montana, South Dakota, Wyoming, Nebraska, the western part of Missouri, Kansas, Colorado, Arkansas, Oklahoma, New Mexico, Mississippi, Louisiana, Texas (Chapters: Denver, Tulsa, Oklahoma City, New Orleans, Austin, North Texas);
10. Alaska, British Columbia, Idaho, Washington, Oregon, Utah, Nevada, California, Arizona, Hawaii (Chapters: Sacramento, San Francisco, Southern California, Hawaii).

Districts of the American Statistical Association

As of September 1956



FEDERAL STATISTICAL ACTIVITIES

1959 Budget Recommendations for Principal Statistical Programs

Budget recommendations for fiscal year 1959, presented to the Congress on January 13, include about $34.9 million for principal current statistical programs —an increase of $2 million over the amount available in 1958. Most of this increase is for an integrated program designed to remedy some of the most important weaknesses which have been pointed out in recent appraisals of the adequacy of existing economic statistics for purposes of economic analysis. The program includes a number of interrelated proposals, integrated within the framework of the national income and product accounts, for strengthening statistical series in areas where immediate improvement is needed and is feasible.

The 1959 recommendations for principal statistical programs are summarized in Special Analysis I of the 1959 Budget Document by broad subject areas, as in previous years. The program changes recommended are, in brief:

Labor statistics: Increases are requested for two projects in the Bureau of Labor Statistics designed to strengthen estimates and analysis of changes in labor productivity: (1) $100,000 to expand information on hours collected in the employment, hours and earnings series, to provide better information for the computation of productivity indexes; and (2) $85,000 to provide for computation of productivity indexes for selected individual industries.

Demographic statistics: An increase of $135,000 is recommended for the U. S. National Health Survey program, to meet the needs for full-year operation of the program at the level planned.

Prices and price indexes: An increase of $100,000 is recommended for price statistics in the Bureau of Labor Statistics to provide additional price information needed for improving the national accounts and also to provide improved price deflators for use in measuring changes in productivity and inventories.

Production and distribution statistics: Increases totaling about $375,000 are recommended for the Bureau of the Census to provide for (1) preparation of monthly estimates of retail and wholesale inventories for a limited number of commodities; (2) collection of monthly data on receipts of selected service trades; (3) collection of monthly information on accounts receivable from retail trade establishments; and (4) revision and enlargement of the reporting sample for the Monthly Industry Survey to obtain more adequate current data on manufacturers' sales, inventories and new orders.

Construction and housing statistics: An increase of $500,000 is recommended for a survey program in the Bureau of the Census to collect the primary data needed to correct deficiencies in present estimates of (1) the amount of new construction of certain types, and (2) expenditures on repair and alteration for different types of existing properties.

National income and business financial accounts: A number of increases are recommended in this area as part of the integrated program to improve basic economic data. About $200,000 is recommended for the Office of Business Economics for four projects designed specifically to improve the national income and product accounts. Also in the Office of Business Economics, $50,000 is recommended for the first year of a two-year program to take a comprehensive survey of United States direct private investments abroad; and $30,000 for further work on current analysis of business trends, including resuming publication of quarterly statistics on business births and deaths. In the Bureau of the Census, about $100,000 is recommended for a quarterly survey of State and local government finances to include capital outlays and current expenditures as well as revenues, indebtedness, and financial assets. An increase of $300,000 is recommended in the budget for the Small Business Administration to provide for the collection of current information on the financial position of small and large corporations in trade and mining industries.

In addition to the requests for current programs, the 1959 budget requests of $7.3 million for the 1958 censuses of business, manufactures, and mineral industries; $7.0 million for preparatory work for the 18th Decennial Census; and about $400,000 for completion of the 1957 Census of Governments.

Single copies of Special Analysis I of the 1959 Budget, on "Principal Federal Statistical Programs," may be obtained from the Publications Unit, Bureau of the Budget, Washington 25, D. C.

—Raymond T. Bowman,
Assistant Director for Statistical Standards,
Bureau of the Budget

Progress on 1960 Censuses of Population and Housing

Planning is proceeding on the content and procedures for the 1960 Censuses of Population and Housing, and it is expected that a full-scale operational pretest will be held in the fall of 1958. Meetings have been held with all the governmental and nongovernmental advisory groups established last year to aid in achieving maximum efficiency and usefulness in the census operation.

In general, plans for the censuses are being developed under the guiding principle that the 1960 Census program must be kept at the level of the 1950 program, with allowance for increased costs resulting from the larger population and higher unit costs, offset in part by economies resulting from improved procedures and greater use of sampling. New inquiries or tabulations cannot be added to the 1960 program, therefore, except by reduction of the 1950 program or further improvements in procedures.

For the Census of Population, agreement has been reached that items relating to labor force status, occupation, industry, and class of worker (collected on a complete-enumeration basis in 1950) will be collected on a sample basis in 1960. These items as well as other items (e.g., residence a year ago, education, and income) which were collected in 1950 from a 20 percent sample of individuals will be collected in 1960 from a 25 percent sample of households. It is expected that use of the household sampling scheme in the 1960 Census will make possible substantial improvement in estimates of family income.

It has also been decided not to include a question on religion in the schedule for the Census of Population, as had been proposed, because of the concern expressed by many individuals and organizations about the implications of such a question for religious freedom. It had also been proposed that the 1960 schedule include a request for social security numbers, in order to facilitate matching studies to aid in evaluating the validity of the census data and in providing supplementary information about the population. It has been decided not to include this question on the census schedule, in view of the costs and difficulties involved, but that the need for social security numbers for special studies may be met in other ways—e.g., by a question in the post-enumeration survey, or directly from the records of the Bureau of Old-Age and Survivors Insurance. Other proposals which have been made for inclusion in the schedule for the 1960 Census of Population are still under study or being tested in the field.

For the Census of Housing, special working groups have been established to work on improvement or refinement of various items in the schedule. One working group is investigating the feasibility of establishing a third category for designating the quality of dwelling units in addition to the two categories, "dilapidated" or 'not dilapidated," used in the 1950 Census. Other groups are reviewing the definitions of living quarters and the classification of vacant units.

New procedures to improve the coverage of the censuses are also being investigated, particularly in connection with the special censuses taken from time to time in various communities. Although no decisions have been reached regarding any of these new procedures, work is going ahead on the assumption that some new measures to improve coverage will be adopted for the 1960 Censuses.

In the area of geographic planning, the tracting of cities and of the standard metropolitan areas is moving forward, with the expectation that some 22,000 tracts will be recognized in the 1960 Census as compared with 12,500 recognized in 1950. Delineation of the new Census County Divisions is well under way, and will be used in at least 14 Western and Southern States in the 1960 Census. These new county divisions have been developed to replaced minor civil divisions for presentation of small-area data in areas where the civil divisions were unsuitable for statistical purposes because their boundaries are unstable and not generally recognized. The new county divisions have permanent boundaries and are organized so that a single division or combination of divisions will provide data for areas approximating communities or trading areas.

A working model of Fosdic III (Film Optical Sensing Device for Input to Computers) has been constructed and is currently being tested. The first of the new Univac 1103 b's, which will be used in the 1958 Censuses of Business, Manufactures and Mineral Industries as well as in the 1960 Decennial Census, is being installed at the Census Bureau.

—Conrad Taeuber, Assistant Director,
Bureau of the Census,
Department of Commerce

Planning for the 1958 Census of Business

Plans for determination of questionnaire content and processing methods for the 1958 Census of Business are now well under way. The Census Bureau has held two meetings with the American Marketing Association's Census Advisory Committee in which broad data objectives and area presentation problems were reviewed, and has met with the American Statistical Association's Census Advisory Committee and the Newspaper Advisory Committee to review their recommendations. A statement has also been distributed to members of the American Retail Federation outlining Census problem areas and requesting their recommendations.

Drafts of forms to be used in the retail, wholesale, and service phases of the 1958 Censuses are being submitted to the Budget Bureau in January and February. Copies are also being circulated to governmental agencies for a general meeting to be called in February. A program for clearance of form content with trade organizations will be conducted during the first quarter of 1958. Plans call for completion of setting questionnaires in type by the end of June.

As in the 1954 Census, it appears now that no retail merchandise-line data will be collected in the 1958 Census. The possibility of collecting and publishing

data for retail trade is under consideration for the following subjects: (a) plant and equipment expenditures; (b) credit and accounts receivable; (c) inventories; and (d) value added. Collection of plant and equipment expenditure and value-added data is also being considered for wholesale and service trade. Data on these subjects would be based on a sample. Information on value added has been included in the Census of Manufactures for many years. Inclusion of such information as part of the Census of Business, however, raises definitional and collection problems which must be resolved before this inquiry can be added.

—Louis Greenberg, Assistant Chief,
Business Division,
Bureau of the Census,
Department of Commerce

Revision of Weights for BLS Wholesale Price Index

The Bureau of Labor Statistics is now making a routine revision of the weighting structure of the Wholesale Price Index. The new weight diagram will incorporate data on net selling volume of commodities in the year 1954, as reported in the latest Census of Manufactures, Census of Mineral Industries, and other sources. This is in accord with established policy of the Bureau that the weighting structure of the Wholesale Price Index will be revised periodically when data from the economic censuses, now scheduled at five-year intervals, become available.

The revised index will be introduced early in 1958. Current plans call for publishing both (1) a preliminary and (2) a revised, unofficial, January 1958 index using the old weights. In April 1958, a recomputed "official" January 1958 index, based upon the new weights, will be published. The preliminary February index will be based on the old weights; the revised, "official" February index will be published in April based upon the new weighting structure. Beginning with the March data, both the preliminary and final indexes will be based upon the new weights.

At the time that the new value weights are introduced, the index will be calculated back for one full year, using the new weights, in order to measure their effect on the index. As soon as possible thereafter, this calculation will be carried back to 1954 or earlier. The previously published indexes through December 1957, however, will continue to be the "official" WPI.

Except for revisions in a limited number of areas, the samples of commodities and pricing methods are not being changed at this time. Changes are being made in the gas and electricity components of the Wholesale Price Index, and there will be some minor changes in the classification of commodities. Needed expansion of product coverage and improvements in pricing cannot be undertaken with the resources now available.

The present index reference base, 1947-49 = 100, will be continued. This base was established by the Office of Statistical Standards of the Bureau of the Budget in 1951 as a standard base period for use by Government statistical agencies in constructing index numbers.

—Sidney A. Jaffe,
Division of Prices and Cost of Living,
Bureau of Labor Statistics
Department of Labor

National and Regional Data from the 1956 National Housing Inventory

The Bureau of the Census has issued press releases giving national and regional figures for the components of change in the housing inventory of the United States. The new releases, like those issued earlier for nine standard metropolitan areas (see December 1957 issue of *The American Statistician*, p. 11), present data reported in the National Housing Inventory survey conducted as of December 31, 1956.

The national and regional releases show the inventory of dwelling units on December 31, 1956 and April 1, 1950, the net increase in numbers and percentage, and the components of change between 1950 and 1956—additions from new construction, conversion, and other sources, and losses from demolitions, mergers, and other means. The national release presents these figures for the United States and for territory inside and outside standard metropolitan areas. The regional release presents the data for the United States and for four regions—Northeast, North Central, South, and West.

For the United States, additions during the period totaled about 12.6 million dwelling units, of which about 10.9 million represented new construction, while losses totaled about 3.2 million, making a net increase from the 1950 inventory of about 9.4 million or 20.4 percent. The percentage increase in the four regions was: West—32.6, South—21.8, Northeast—17.8, and North Central—15.3. In terms of numbers, the largest number of additions and also of losses occurred in the South, where a total of 4.3 million dwelling units were added and 1.3 million were lost.

The National Housing Inventory data on units added by new construction cannot be compared directly with the Bureau of Labor Statistics series on new permanent nonfarm dwelling units started during the same period. Comparison is not statistically valid unless account is taken of differences in concepts and definitions, differences in timing of starts versus completions, and other differences arising from the procedures followed by the two agencies. In particular, the NHI includes 200,000 new trailers and 590,000 new rural houses in which the occupant indicated that he lived on a farm, while

the BLS series by definition excludes mobile homes and rural farm houses. Further, the BLS series covers only housing designed and constructed as permanent housekeeping units suitable for year-round occupancy, whereas the NHI includes dwellings of all types.

Even after allowances have been made, however, for those differences between the NHI and BLS series for which estimates are available (trailers and farm units), the NHI series is still found to be about 25 percent greater than the BLS series. Some of this difference can be explained in terms of differences in concepts and coverage for which no satisfactory measures are available, and some may be accounted for by sampling variation. At the request of the Bureau of the Budget, special studies are being planned by the Bureau of the Census and the Bureau of Labor Statistics to explain the discrepancies now apparent, in order to make it possible to use the housing starts series in conjunction with results found in the housing censuses and the National Housing Inventory.

Copies of the press releases showing components of change in the housing inventory for the United States, for the four regions, and for each of the nine standard metropolitan areas (Atlanta, Boston, Chicago, Dallas, Detroit, Los Angeles, New York, Philadelphia, and Seattle) may be obtained from the Housing Division, Bureau of the Census, Washington 25, D. C. Information on additional characteristics of the components of change and of the 1956 inventory, and information on the financing of owner-occupied residential properties, will be published later in 1958.

—Wayne F. Daugherty, Chief,
Housing Division,
Bureau of the Census,
Department of Commerce

"County and City Data Book, 1956"

The Bureau of the Census has issued the "County and City Data Book, 1956" as a supplement to its annual Statistical Abstract of the United States. The new volume presents 133 items of information for each county and for each State, region, and geographic division; 99 items for each of 172 standard metropolitan areas; and 130 items for each of 484 cities having 25,000 or more inhabitants in 1950.

The broad areas of subject matter cover: area; population; dwelling units; telephones; electric bills; births, deaths, and marriages; retail, wholesale, and service trades; business units; manufactures; agriculture; bank deposits; city finances, employment, and school systems; hospitals; and climate. Separate appendixes give a selection of statistics for Congressional Districts (available as a separate reprint from the Public Information Office, Bureau of the Census) and the latest county indexes of farm-operator level of living. A detailed listing of the items included may be obtained from the Statistical Reports Division, Bureau of the Census, Washington 25, D. C.

As in previous editions, a map section includes a map for each State delineating counties and standard metropolitan areas and showing all cities of 25,000 population or more in 1950. Explanatory and definitive text and source notes are also included.

Most of the statistics in the new "County and City Data Book" were obtained from the results of the 1954 Censuses of Agriculture, Business, and Manufactures. Data from the 1950 Censuses of Population and Housing (the latest available in these fields) and current data from a number of other sources are also included, however, to make the Data Book a reasonably complete reference book in itself.

The annual Statistical Abstract brings together data primarily covering the country as a whole and largely current. The supplements to the Abstract, which appear less frequently, meet two specific needs with which the annual volume cannot deal because of space limitations: (1) the need for summary statistics for small areas, and (2) the need for historical data. The first of these needs is met by the County and City Data Book series. Previous supplements in this series are the "County and City Data Book, 1952" (issued 1953), the "County and City Data Book, 1949" (issued 1952), the "County Data Book" (issued 1947), and the "Cities Supplement" (issued 1944). The need for historical data was met by the supplement on "Historical Statistics of the United States, 1789-1945," issued in 1949 with a Continuation issued in 1954. The historical statistics volume is now in process of complete revision.

Copies of the "County and City Data Book, 1956" may be purchased at $4.50 (buckram) from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

—William Lerner, Chief,
Statistical Abstract Branch,
Bureau of the Census,
Department of Commerce

Among Recent Publications—

The National Economic Accounts of the United States, issued by the Joint Economic Committee, U. S. Congress. Hearings held October 29-30 by the Subcommittee on Economic Statistics on the report of the National Accounts Review Committee, established last year by the National Bureau of Economic Research, on request of the Office of Statistical Standards, Bureau of the Budget. The full text of the Review Committee's report ("The National Economic Accounts of the United States: Review, Appraisal, and Recommendations") is included,

as well as testimony of the Review Committee members (Raymond W. Goldsmith, chairman, V. Lewis Bassie, Gerhard Colm, Richard A. Easterlin, Edwin B. George, Joseph A. Pechman, Roy L. Reierson, Richard Ruggles and Lazare Teper); and of representatives of producers and users of national-accounts statistics (Raymond T. Bowman, Ewan Clague, Edward F. Denison, Martin R. Gainsbrugh, Peter Henle, Robert E. Johnson, Charles F. Schwartz, Ernest A. Tupper and Ralph A. Young). Available at 75 cents a copy (302 pages) from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Federal Expenditure Policy for Economic Growth and Stability, issued by the Joint Economic Committee, U. S. Congress. Compendium of papers prepared by nearly 100 panelists who appeared in hearings before the Subcommittee on Fiscal Policy on November 18-27, exploring a wide range of issues bearing on public expenditures. Papers deal with the historical development of Federal expenditures and their role in the Nation's economic growth; basic economic principles and criteria bearing on the relationship between activities of the Federal Government and objectives of the Employment Act; and the impact on economic growth and stability of major Federal spending programs (e.g., national security, foreign aid, natural resource development, regional development, housing and urban redevelopment, development of human resources, transportation and other public works, and research and development). Available at $3.25 a copy (1203 pages) from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

U. S. Investments in the Latin American Economy, issued by the Office of Business Economics, Department of Commerce. Complete results of a special survey of the operations of U. S. direct investments in Latin America, presenting an overall view of the share of U. S. companies in the economic activity of Latin America, with data in production for export and local consumption, imports of capital equipment and materials, remittances of income and fees, contributions to local incomes through payments for materials, wages, taxes, etc., and numbers of local and U. S. employees. Data are also given on gross investments for plant and equipment, inventory accumulation, and development and exploration of new resources, with a breakdown of the sources of funds used by the companies. Separate sections on major industries (petroleum, manufacturing, mining and smelting, agriculture, and public utilities) and countries (Argentina, Brazil, Chile, Colombia, Cuba, Mexico, Peru, Venezuela, and Central America, the Dominican Republic and Haiti). Available at $1.75 a copy (194 pages, 118 charts) from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., or from the field offices of the U. S. Department of Commerce.

Analysis of Health and Insurance Plans Under Collective Bargaining, Late 1955 (Bulletin No. 1221), issued by the Bureau of Labor Statistics, Department of Labor. Comprehensive analysis of the provisions of 300 selected health and insurance programs under collective bargaining (each covering 1,000 or more workers) in effect in late 1955. The report presents detailed statistics on provisions under the 300 plans, for active and retired workers and their dependents, relating to levels and amounts of life insurance and of benefits for accidental death and dismemberment, accident and sickness, hospitalization, and surgical, medical and maternity care. Available at 50 cents a copy (87 pages) from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

The Federal Research and Development Budget, Fiscal Years 1956, 1957, and 1958, issued by the National Science Foundation as Volume VI in its series on *Federal Funds for Science*. Analyzes the Federal scientific research and development budget according to administering agencies, scientific fields, character of work, and organizations performing the research and development activities for the government (government agency, profit organization, educational institution, other nonprofit). Changes introduced in this edition include a distribution of funds for increase of research and development plant based on location of facilities and separate identification of research funds and development funds. Available at 40 cents a copy (60 pages) from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Charles F. Roos, one of the country's outstanding economic forecasters, died in Milwaukee on January 7 at the age of 56. Dr. Roos received his B.A. and Ph.D. degrees from Rice Institute. He taught mathematics at Rice and Cornell and econometrics at Colorado College. From 1933-34, he was Director of Research for the National Recovery Administration. In 1938 he founded the Econometric Institute, a consulting firm for the measurement and forecasting of economic trends through the use of mathematical methods, and was Chairman of the Board when he died. Dr. Roos was the author of several books and numerous papers. He was a Fellow of the American Statistical Association, the Institute of Mathematical Statistics and the Econometric Society, of which he was President in 1948.

AN OUTLINE OF INFORMATION THEORY

E. N. Gilbert

Bell Telephone Laboratories, Inc.

Introduction

One might suppose that the field of communication engineering would contain little of direct interest to statisticians; indeed this was once true. Communication problems seemed then to be centered about questions of electrical circuit design and to have no close connection with statistics. Recently however statistical ideas have found a prominent place in communication theory. A new statistical approach to communication theory has stimulated a flood of research to which statisticians are contributing. This paper hopes to introduce the statistician, whose main field of interest is remote from communication theory, to some of these developments.

We must first accept the view that such sources of messages as speech, television, teletype, etc. may be described in probalistic terms. This notion may seem artificial; for each of us, at times, acts as a message source and we may like to think that our own messages are not randomly produced. Nevertheless communication theory takes the point of view of the recipient of a message or of the engineer who must provide the communication service. To them, in their ignorance of the detailed inner workings of the message source, the source appears very much like a random process. Take, for example, this article as the message with yourself as recipient. Even without reading further you might say that there is a high probability that the next page will contain more E's than any other letter. On the basis of past letter counts you might estimate the probability that H will follow T, the probability that a word chosen at random will end in Y, etc. The idea of using such statistical properties of language is a very old one in cryptography. A discussion of their use in decipherment together with a fascinating historical account is given by F. Pratt [16]. In communication theory one now attempts to exploit statistical properties of messages in order to send them faster or cheaper. A familiar example of this kind is the Western Union system of numbered telegrams which is based on the statistical fact that a good fraction of all telegrams say essentially "Happy Birthday." Another is our use of abbreviations like Mr., Xmas, NATO, for common English words and constructions.

In most communication systems statistical questions also arise naturally because of the presence of random agencies (which we will call *noise* hereafter) which make the received message depart from the original in an unpredictable way. Modern statistical communication theory offers ways of combatting noise and ways of evaluating the capabilities of noisy communication systems.

Many statistical problems fall into the following two categories. There are problems of data analysis in which an experimenter has collected some data and a statistician must draw conclusions from it. There are also problems of experimental design in which the statistician must decide in advance what measurements must be made in order that the data analysis problem which follows may be particularly revealing. Two closely analogous kinds of problems confront the communication engineer.

The act of transmitting a message is an experiment in which the received message is the data obtained. This data may be a high-frequency wave or a pattern of holes punched in paper tape which the engineer, by a suitable circuit, must put into a form for human consumption. The output of this circuit is an estimate, prepared by the engineer, of the original message generated by the source. In this sense the engineer designing the receiving equipment of a communication system is a statistician deciding on a program of data analysis. Until recently this analogy might have seemed forced because the methods of designing receiving equipment bore no resemblance to standard statistical techniques. Nowadays however one may find such design problems attacked by statisticians' methods of hypothesis testing, parameter estimation, and decision making (see U. Grenander [6] and D. Middleton and D. Van Meter [12]; the latter paper contains a large bibliography of current articles). An early step in this direction was taken by N. Wiener [22] and A. N. Kolmogoroff [9] in fire-control problems. Here the original message is a function of time $x(t)$ representing a coordinate of a target; the received message is of the form $x(t) + n(t)$ where $n(t)$ is a random noise function. Wiener and Kolmogoroff independently found a best estimate $X(t)$ of $x(t)$ in the form of a linear combination of values of the received message for times up to t. The estimate is best in the sense that the error $X(t) - x(t)$ is a random variable with mean zero and a minimum variance. Naturally the form of the estimate $X(t)$ depended on statistical properties of both $n(t)$ and $x(t)$; this work marked the point at which the statistical view of communication gained a widespread acceptance.

The second kind of statistical problem, the design of an experiment, came into communication theory following the invention of a large variety of different types of communication systems. The modern radio engineer can transmit speech signals by AM, FM, phase modulation, pulse code modulation, delta modulation, or can easily devise new schemes. In choosing one of these systems the engineer is really designing an experiment which must be such that the "experimenter" at the receiving end can make good guesses about what was transmitted. The relevant part of modern communication theory has

a strong statistical flavor although it is not exactly like "design of experiments" as studied by statisticians. Some of the difference arises from the acceptability of a priori distributions in communication theory. The basic theory is due to C. E. Shannon [18]. Since an adequate résumé of the entire subject of statistical communication theory would be too lengthy we shall give just an expository treatment of Shannon's information theory and some related topics. This choice permits a discussion which requires no special engineering background and serves to introduce some ideas which have spread beyond communication theory into cryptography [19], linguistics [1], psychology [17], and mathematical statistics [11].

Information

In information theory one uses a numerical measure of amounts of information. "Information" is a word which suggests different things to different people so an explanation is needed of what is to be measured. The engineering usage of the word reflects the notion that the time required to transmit a given message, say a cablegram, is an indication of how much information the message contains. Thus "amount of information" is to be defined here in a way which makes it especially suitable as a measure of the time, or equivalently the cost, of sending a message. Other intuitive ideas about information are apt to be misleading when applied to this measure. Particularly, a message may have a large amount of information without being "informative" in the sense of saying something useful or even true. After all, nonsense and lies are just as expensive to transmit as great truths. People who make physical measurements are apt to say that the digit 3 in 3.26, being the most important, carries more information than the others; or conversely they may say the 6 has most information since it is most difficult to measure. Neither of these usages corresponds to ours. Still another meaning is used by R. A. Fisher [4] in a classically statistical context. It should now be clear that we are not about to say "what information really is." Instead we will define a useful quantity which happens to have been given the loaded name "information."

Information will be a measure of time or cost of a sort which is of particular use to the engineer in his role of designer of an experiment. Messages can be transmitted by many schemes, some of which will consume more time than others. Shannon's information will turn out to measure the time required to send messages when using the fastest transmission scheme possible. This information is not so much a property of an individual message as it is a property of the experiment which produces the messages. For example consider the message "Meeting you has been a pleasure." These words, spoken by someone you have just met and who is now leaving, convey practically no information; for parting words are almost guaranteed to be one of a small selection of polite utterances. If an engineer had to provide means of transmitting parting words only he could simply number the 20 or 30 acceptable sentences and transmit the appropriate number (decoding it back into English before delivering the message). The sentence in question might also be spoken under entirely different circumstances when a tremendous variety of other sentences is possible. Now the same sentence is associated with more information. In any case, the information will depend only on the number of alternatives and their probabilities, not on the particular message chosen. Nevertheless, one uses the words "information in message M" as a convenient shorthand for the more precise words "information associated with the experiment which produced M."

Consider an experiment x whose outcome is to be transmitted. We will be particularly interested in cases in which the outcome of x is an honest message, say written English or a television image, but for the moment consider experiments in general. First of all, suppose x has n equally likely outcomes. In this special case Shannon's definition of information evolves naturally from the following argument. The information in the message about x will be some function f (n). Suppose x is a compound experiment consisting of independent experiments y and z which have n_1 and n_2 equally likely outcomes. Transmitting the outcome of x is equivalent to transmitting the outcomes of y and z separately. Thus the information (expense) of x must be the sum of the informations of y and of z, i.e. $f(n_1 n_2) = f(n_1) + f(n_2)$. This functional equation has many solutions. To name two, f(n) might be log n or f(n) might be the number of factors into which n may be decomposed as a product of primes. However, one has other requirements on f(n). The time required to transmit the outcome of x will certainly be an increasing function of n. Hence we need consider only those solutions f (n) which are increasing functions; the only such solutions turn out to be the constant multiples of log n. It is customary to take the constant multiplier to be one and to take two as the base of a logarithm. Then the information is measured in units called bits; i.e. one bit is the information associated with an experiment with two equally likely outcomes. If the outcome is certain (n = 1) the recipient of our messages knows the outcome even if we transmit nothing. Accordingly, we find f (1) = log 1 = 0.

Suppose the n possible outcomes of x are not all equally likely; let them have probabilities $p_1, \ldots, p_n$. In this case the amount of *information* in the message about x is defined to be

$$H(x) = -\sum_{i=1}^{n} p_i \log p_i.$$

This sum bears a close formal resemblance to a quantity called *entropy* in statistical mechanics. For this reason H(x) is also called the entropy function of $p_1, \ldots, p_n$.

We now give some of the properties of the entropy function which make it an appropriate measure of infor-

mation. First of all, when the n outcomes are equally likely, $p_i = 1/n$. Then H (x) does reduce to log n, as it should. Also, for a fixed number n of outcomes, the case of equally likely outcomes is the one in which H(x) attains its maximum value. This seems reasonable in view of known examples, such as the numbered telegram example cited earlier, in which large differences among the p_i help to reduce the average cost of a message. Next if x consists of two independent experiments y and z, one finds $H(x) = H(y) + H(z)$. In words, the information associated with x is the sum of the information of its constituents y and z. If y and z are not independent then $H(x) < H(y) + H(z)$. This again is reasonable. Some of the H(y) bits of information about the y experiment give information about the possible outcome of the z experiment and so are counted twice in the sum $H(y) + H(z)$. The correct relationship between H(x) and the y and z experiments is also reasonable. Suppose one knew that the y experiment had the k^{th} outcome. With this knowledge in mind the probabilities for the various z-outcomes would change to conditional probabilities and the information obtained by then performing the z-experiment would be the entropy function $H_k(z)$ of these conditional probabilities. If P_k is the probability of the k^{th} outcome for y, then $H_y(z) = \sum_k P_k H_k(z)$ is the mean amount of additional information obtained from the z experiment after the results of the y experiment are known. $H_y(z)$ is called the conditional information about z knowing y. As one might expect, $H(x) = H(y) + H_y(z)$. Then also $H_y(z) \leqslant H(z)$. While these properties strongly suggest the entropy function as a measure of information, the real justifications for using it are the encoding theorems which will be discussed later.

If a deck of 52 cards were perfectly shuffled, all 52! possible arrangements of the cards would be equally likely and the information associated with seeing the deck would be log 52!=225.7 bits. Some measure of the effectiveness of a shuffle is obtained by computing the information associated with seeing the deck after the shuffle, assuming the order of the deck before the shuffle were known. A common shuffling operation is to cut the deck into two packets, top (T) and bottom (B), at a random place and then riffle T and B together. The riffling operation consists of 52 steps at each of which the bottom card of either T or B falls onto the top of the shuffled deck. Then the shuffle is completely described by a sequence of 52 letters T or B. The i^{th} letter is T if at the i^{th} step the card fell from the bottom of packet T (note: the position of the cut may be found from the sequence by counting the number of T's). There are only 2^{52} possible sequences of T and B and hence only 2^{52} possible outcomes of the shuffling experiment. Then at most log $2^{52} = 52$ bits of information are associated with learning the new order of the deck after a single cut and riffle. This shuffle is not very thorough.

As an example of a compound experiment x we may consider the construction of a substitution cryptogram. The two parts of x are y, the construction of the clear text, and z, the choice of a key from one of 26! possibilities. If, as is usually the case, the key and the text are chosen independently, it takes $H(y) + \log 26!$ bits of information to find both the key and the text. It is an experimental fact that substitution cryptograms of 40 letters (counting word spaces as letters) can usually be solved. Since 40 letters can contain no more than 40 log 27 (26 letters and word space are 27 symbols) bits of information, one concludes $H(y) + \log 26! \leqslant 40$ log 27 and hence that the information in a 40 letter English message is $H(y) \leqslant 100$ bits.

Message Sources

We consider here only discrete sources, i.e. sources which produce messages made up of symbols drawn from a finite list or alphabet. Thus a person typewriting or a stock ticker giving market quotations are discrete sources. A speaker is not a discrete source because the values of a speech wave are drawn from a continuum of possibilities. To include non-discrete sources adds to the mathematical difficulties but does not introduce any essentially new concepts.

In information theory one assumes that a good a priori probabilistic description of the source is known. The assumption is a reasonable one because the communication engineer can make a statistical study of the source prior to his design of the communication experiment. Actually the most interesting sources are extremely complicated stochastic processes. In practice one adopts some simple model of the true source.

Take an English text source as an example. A much oversimplified model of this source is one which produces the 27 symbols A, . . . , Z, and word space independently with the correct English text probabilities. A typical message from this source is E OO RAYHHW YI DAT RSUN SUSNR DHRR. A better model is a "digram" source in which each new symbol is chosen with the correct conditional probability given only the preceding symbol. This source produces messages like S PLSERENE THINDE WO ASPOPOT. If each new letter is chosen knowing the preceding pair of letters one has a "trigram" source and messages like THIS OF MANY BE DEPROPHY THERIED WHE. One can imagine more complicated "N-gram" models but the task of measuring the 27^N conditional probabilities which define the source becomes enormous. Some idea of how good such models would be is given by Shannon's experiments with human subjects. For example, a message from a "trigram word source" was constructed by allowing a subject to see two words of a message. The subject then added a reasonable next word, covered the first of the three words, and passed the remaining two words to the next subject. The following message was generated when the subjects were told that the source was to write a detective story.

WHEN I KILLED HER I STABBED CLAUDE BETWEEN HIS POWERFUL JAWS CLAMPED CRUELLY TOGETHER. SCREAMING LOUDLY DESPITE FATAL CONSEQUENCES IN THE STRUGGLE FOR LIFE BEGAN EBBING AS HE COUGHED HOLLOWLY SPITTING BLOOD FROM HIS EARS. BURIAL SEEMED UNNECESSARY SINCE FURTHER DIVISION WAS NECESSARY.

We have tried similar experiments to approximate a source writing music. Some surprisingly good piano music was written by a source in which statistical influences lasted for only four beats. Another source which writes simple melodies is described by R. C. Pinkerton [15].

One would like to define a rate, say in bits per symbol or in bits per second, at which a source generates information. To do so consider a compound experiment x_N performed in two parts y_N and z. In y_N the source produces N-1 consecutive symbols; in z the N^{th} symbol is produced. If N is large, the conditional information $F_N = H_{y_N}(z)$ represents the average amount of totally new information which each new symbol carries. Then the source rate in bits per symbol should be $\lim_{N \to \infty} F_N$. One can also argue for the same formula by noting that F_N is the average amount of information involved in the production of each new symbol by the N-gram approximation to the source.

To compute source rates it appears that we need the probabilities of all possible sequences of length equal to some large number N of symbols. Actually the sequence of numbers F_N decreases monotonically so, even for small N, F_N provides a useful upper bound on the source rate. For the English text source F_1, F_2, and F_3 are 4.0, 3.3, and 3.1 bits per letter. Another estimate of the English rate is obtained by using whole words instead of letters as the message symbols. Using a table of word probabilities, one computes $F_1 = 11.8$ bits per word (Shannon [20]) which is 2.1 bits per letter. In English the rules of sentence structure exert influences which are not felt in short-range calculations like these; the true rate of English is still smaller than 2 bits per letter.

In our cryptogram example above we computed that 40 letters of English text contain at most 100 bits of information. This gives another upper bound of 2.5 bits per letter.

Encoders

An encoder may be described as a purely deterministic (non-random) device which converts a message in one set of symbols into a new message, usually in a different set of symbols. For example, a handwritten English message may be converted into a pattern of holes punched on a tape, then into a sequence of electrical impulses on a teletype wire, back into English letters by a teletypewriter, and finally translated from English into French. The first three of these four transformations are reversible encodings. That means that each incoming message can be encoded in only one way and conversely no two different incoming messages are ever encoded alike. Translation from English into French is not usually an encoding because it may involve random choices. For example, the English word "robbery" may be translated at random into either "vol" or "brigandage". Even assuming that all such choices were settled in advance, one would undoubtedly find some French words representing several English ones, e.g. "vol" for both "robbery" and "theft". Then the encoding would not be reversible.

A reversible encoder transforms messages into encoded messages in a one-to-one way; one gets the same amount of information from the encoded message as from the original message. One would like to conclude that a reversible encoder driven by a source S is a new source S′ with the same rate as S in bits per second. However, this conclusion requires further assumptions about the encoder. For example the encoder might just store the incoming message and re-emit it at a slower rate. Such an encoder would ultimately require an unlimited amount of storage space. If a reversible encoder has only a finite number of internal states (e.g. an encoder made from a finite number of relays or switching tubes) then the encoder output has the same rate as its input.

Another kind of encoder for English (Shannon [20]) uses the idea of prediction. Given any block of N-1 letters of an English message, this encoder consults a table of probabilities for the N^{th} letter and lists the 27 possibilities in order of decreasing probability. For example with N = 2 the encoder, confronted with the one-letter block T, places H first, space second, I third, O fourth, etc. (some probability tables are given by F. Pratt [16] pp. 258-259). When the encoder learns the correct N^{th} letter it emits a number 1, 2, . . ., or 27 telling where the letter stood in the list. The encoding is reversible and the emitted numbers have the same rate as English. In fact, the information associated with the choice of a single number is F_n bits. Lacking the extensive tables needed for such an encoder for large N, Shannon used a human subject who ranked the 27 possibilities by guesswork. Most of the time the correct letter was guessed on the first or second try; the output of the encoder was predominantly 1's and 2's. By computing the probabilities of 1, 2, . . ., 27 and the corresponding entropy, the rate of English was estimated at about one bit per letter.

Channels

A channel is a medium by which information is carried from a source to a destination. A noiseless channel suitable for carrying discrete messages has a finite list of symbols $S_1, S_2, \ldots, S_n$ which it can transmit. Each symbol S_i requires a certain fixed time t_i to be trans-

mitted over the channel; $t_1, t_2, \ldots, t_n$ need not be all the same. For instance, $S_1, S_2, \ldots$ might be the English alphabet expressed in the dots and dashes of Morse code; then the time to send E is less than the time to send J. The channel may also have constraints which prevent certain combinations of symbols from being transmitted. For example, one might imagine the Morse code channel built so that a given list of obscenities is automatically replaced by sequences of X's of appropriate length.

The combination of a channel fed by a source may be regarded as a new source which generates the message at the receiving end. The information rate of the received message will depend on the transmitting source. For example, suppose a channel can transmit English letters and word spaces at the rate of one symbol per second. When the channel transmits English text, it has a rate of about one bit per second. If the same channel is connected to a source which produces letters and spaces independently with probability 1/27 for each kind of symbol, the rate is log 27 = 4.76 bits/sec. The largest rate at which one can signal over a channel, for all choices of the source, is called the *capacity* of the channel. The capacity of the English letter channel just discussed is log 27 bits/sec. More generally if there are n channel symbols, each requiring time T, and no constraints, then the capacity of the channel is (log n)/T. In this case the maximizing source produces symbols independently with probability 1/n for each kind of symbol.

In the example of the English text source connected to the English letter channel one feels that much of the capabilities of the channel are wasted. Information is transmitted at a rate only 20% of the rate attainable with other sources. Is it possible to speed up the source and still use the same channel? Encoding provides the means for doing so. It is possible to encode English text reversibly in such a way that the encoded messages use fewer letters than the original messages. Then the encoded text may be transmitted at a higher information rate than the original text could. In general, if a channel has capacity C bits per second, the output of any source may be transmitted over the channel at rates arbitrarily close to C bits per second by placing a suitable reversible encoder between the source and the channel. Of course, the way C is defined eliminates the possibility of signalling faster than C bits per second over the channel. These properties of the capacity C of a discrete noiseless channel constitute the simplest case of Shannon's encoding theorems.

The communication engineer's experimental design problem now appears to be one of designing a good encoder. To give some indication of how to encode we consider a very simple example. The source will have two symbols A, with probability 4/5, and B, with probability 1/5. Successive symbols are generated independently. The rate of the source is $-1/5 \log 1/5 - 4/5 \log 4/5 = .72$ bits per symbol. Suppose the channel transmits two symbols 0 and 1 without constraint and suppose 0 and 1 both require one second of transmission time. The channel capacity is one bit per second. If we sent 0 for A and 1 for B the rate would be only .72 bits per second. A better rate can be had by encoding blocks of two letters. Send 0 for AA, 10 for AB, 110 for BA and 111 for BB; then a typical message ABAAAABBAAAA is encoded into 100011100. On the average a pair of letters is encoded into 1.56 digits. Then the source rate is increased to $.72 \times 2/1.56 = .92$ bits per second. Still better rates may be had by encoding longer blocks. In order to transmit at a rate near the channel capacity the encoder must convert the source into one which resembles the maximizing source for the channel. The digits should be nearly independent and have probabilities near ½ for each of 0 and 1. An encoding method has been found by Shannon [18] and independently by R. M. Fano [3]. We illustrate it here by the encoding of blocks of three letters in Table I.

TABLE I

Letters	Prob.	Digits
AAA	.512	0
AAB	.128	100
ABA	.128	101
BAA	.128	110
ABB	.032	11100
BAB	.032	11101
BBA	.032	11110
BBB	.008	11111

Blocks of three letters are listed in order of probability. The high probability blocks are given first digit 0, the rest are given first digit 1; the distinction between high and low probability blocks is made in such a way that 0 and 1 have probabilities as close to ½ as possible. Since AAA turns out to be the only block with first digit 0, this digit alone at the start of a code identifies AAA; no more digits need be added to its code. Continuing, one adds second digits so that 10 and 11 have probabilities near ¼, third digits so that 100, 101, 110, and 111 have probabilities near ⅛, etc. Whenever a block of digits (say 101) is reached which has only one block of letters (ABA) associated with it, no further digits need be added to that block. Finally, one obtains a reversible encoding in which high probability blocks have shorter codes than low probability blocks. On the average, 2.184 digits are sent for each three-letter block. The rate is .99 bits/sec.

As another somewhat more realistic example we may imagine ourselves in the position of Samuel F. B. Morse trying to design an efficient Morse code. The channel is one which can transmit the following symbols:

dot(d) — an impulse lasting one time unit followed by silence for one time unit.

dash (D) — an impulse for three time units followed by silence for one time unit.

space (S) — silence for two time units.
The international radiotelegraph encoding now in use encodes English letters into sequences of d, D, and S. Each new letter begins with a letter space S and an extra space S is added between words. Thus the encoding is of the form; word space — S, A — SdD, B — SDddd, etc.

Suppose instead that we try to encode by modification of the Shannon-Fano scheme. We must first find the maximizing source for the channel. It will emit symbols d, D, S independently but not with equal probabilities. In fact a simple maximization shows that these probabilities are Prob (d) = Prob (S) = $\sqrt{2}-1$ = .414 and Prob (D) = .172. In encoding we must try to achieve these probabilities and independence. Part of the calculation is shown in Table II. The missing letters have total probability .149 and all have codes beginning with D. In our complete code it turns out that, on the average, it takes 6.69 time units to send a letter. The average time using the international radiotelegraph encoding is 7.78 time units. Our code requires 14% less time than the usual encoding. This is a very small gain when one considers that we have lost the convenience of having all codes begin with S. We conclude that the designer of the international radiotelegraph encoding had a good appreciation of the statistical nature of his problem.

The encoding theorem for the general noiseless discrete channel can be made plausible by the following argument. Suppose the channel has capacity C. Then there is a source S_0 which can signal over the channel at a rate as close to C as desired. Suppose we have another source S. By the Shannon-Fano process of Table I we can design reversible encoders E_0 and E which allow S_0 and S to signal over the binary channel with rates near one bit per digit. Now S encoded by E is a source which resembles the maximizing source for the binary channel. If the output of E is decoded as though the encoding had been E_0, the result is a source which resembles S_0. Thus we have encoded S into a source with nearly the same statistical properties as S_0. Hence S, so encoded, will also signal over the channel at a rate near C.

TABLE II

Letter	Probability	Our Code	Time	Radio-Telegraph Code	Time
space	.182	SS	4	S	2
E	.108	SdS	6	Sd	4
T	.086	Sdd	6	SD	6
A	.067	SD	6	SdD	8
O	.066	dSS	6	SDDD	14
N	.058	dSd	6	SDd	6
R	.056	dSD	8	SdDd	10
I	.052	ddS	6	Sdd	6
S	.050	dddS	8	Sddd	8
H	.043	dddd	8	Sdddd	10
D	.031	ddD	8	SDdd	10
L	.028	dDS	8	SdDdd	12
F	.024	dDd	8	SddDd	12

In most channels there is noise. The output of the channel is not simply a function of the input message. Instead, for each possible input message, a variety of received messages is possible. A probabilistic description of the channel is supposed given so that the conditional probability of any received message may be computed for each choice of input message.

Again encoding provides a means for obtaining reliable transmission from a noisy channel. One of the simplest encodings is to repeat each message several times. R. W. Hamming's error-correcting codes [7] provide a more subtle example. The channel in this case transmits strings of two symbols 0, 1, occasionally changing a 0 to a 1 or a 1 to a 0. Instead of sending 0's and 1's without restriction one agrees to send them only in certain combinations, such as the following 4 blocks of 5 digits:

B_1	00000
B_2	11100
B_3	00111
B_4	11011

Each block B_i differs from each other block B_j in at least 3 of the 5 places. If the block B_i is transmitted and one of the five digits is changed by the noise, the received block still differs from all other blocks B_j in at least 2 places. Then the correct block B_i may still be identified as the only block which differs from the received block in at most one place and the wrong digit may be corrected. One may achieve more reliable transmission by encoding the source to use the blocks $B_1, \ldots, B_4$ than to use the digits 0, 1 unrestricted. More generally, if one can find an "alphabet" of blocks $B_1, B_2, \ldots, B_k$ of D digits each such that every pair B_i, B_j of blocks differs in at least $2E+1$ places, then as many as E wrong digits may appear within a block without causing a transmission error. Hamming's paper gives a construction of a single-error-correcting alphabet ($E=1$) for each D. Good alphabets with $E \geqslant 2$ are harder to find; some are given by D. Slepian [21].

The extra reliability of error-correcting alphabets is had at the price of a slower rate. Using $B_1, \ldots, B_4$, the source rate can be at most 2/5 bits per digit instead of the one bit per digit possible using 0, 1 unrestricted. Intuitively one may feel that to signal more and more reliably over a noisy channel the source rate must ultimately become vanishingly small. Fortunately this intuition is wrong. Shannon's encoding theorem for the noisy channel has the remarkable conclusion that even a noisy channel has a capacity C which typically is not zero. No matter how low the rate of making errors must be, one can have this low error rate and still signal over the channel with a source rate as close as desired to C bits per second. It becomes more difficult to signal as the error requirements become more stringent but

only because the encoding becomes very complex and requires a long delay. If practical considerations force one to use simple alphabets one may have to waste a good faction of a channel's capacity [5].

Channel Utilization

A typical telephone circuit has a channel capacity of the order of 20,000 bits/second. Channels of capacity 50,000,000 bits/second are used to transmit television signals. By sufficiently complicated encoding these capacity requirements could be greatly reduced. The channels currently used for speech and television are suitable for sources with much less statistical constraint. For example, a television image can be approximated with good accuracy by a rectangular array of 200,000 dots, each of which may have one of 64 brightness levels. Images are sent at the rate of 30 per second. Television channels could transmit these 6,000,000 dots per second even though their brightness levels were entirely independent. Actual television signals are much more constrained. A television image tends to have large areas at nearly the same brightness. Successive images are nearly identical, except for relatively infrequent changes of scene. These dependencies make the television rate much lower than 50,000,000 bits/second. It is a tantalizing thought to imagine speech or television signals encoded to use only a fraction of the present day capacities. Can we, say, quadruple the usage of our transatlantic cable by some encoding trick?

The vocoder [2] is an encoding device for speech which can reduce the capacity by a factor of about 20 at the expense of a small amount of distortion. Some statistical measurements on television signals have been made [10] and some relatively simple encoding schemes [8] have succeeded in slightly reducing the capacity requirements. There is no doubt that great statistical savings are possible but saving in channel capacity must always be balanced against cost of encoding and decoding.

A related investigation has been made of the ultimate destination of most messages, the human brain. The brain acts somewhat like a channel when it carries messages from sensory centers to the muscles. The "capacity" of the brain may be estimated by devising experiments in which information is processed correctly by the brain as rapidly as possible. For example, a skilled typist can scan English text and type it at the rate of 70 words per minute, about 5 bits per second. The best telegraphers also perform at about this rate. The highest rates known were obtained in reading experiments conducted by J. R. Pierce and J. E. Karlin [14] (for some other experiments see G. A. Miller [13]). Their subjects read word lists at 42 bits per second.

These experiments suggest that the information in a television signal arrives so fast that the mind can only appreciate a small fraction of it. Of course different television viewers will be appreciating different small fractions of the screen at the same time. Nobody seriously suggests that television could be sent over a 42 bit per second channel. There is however the suspicion that much of the information in a television signal is of no use to anybody. One would like to remove this wasted information at the source so that less channel capacity would be needed to transmit whatever remains.

Thus, in addition to the theoretical research with which we have been mainly concerned here, communication theory has some important problems in statistical measurement. To encode messages efficiently, one must first measure statistical parameters of the source. For many applications, psychological measurements are required to determine just what facts must be included in a message. These measurement problems are very difficult and elusive. One cannot obtain a complete statistical description of most real sources merely by measuring a small number of statistical parameters; it is not always clear how to select a few, most significant, parameters for measurement. Communication theory promises to remain a good source of statistical problems.

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DEMAND AND SUPPLY OF STATISTICIANS NOW AND IN THE FUTURE

During the Annual Meeting of the American Statistical Association last September the critical shortage of statisticians was the subject of one of the sessions. While a consideration of the problem and its remedy is within the special area of the Association's Section on Training which is headed in 1958 by Professor Boyd Harshbarger the subject is of vital interest to all producers and users of statisticians.

Messrs. Harshbarger, Bancroft and Futransky have condensed and brought up to date three of the papers given at this session. Two very interesting points they have made stand out in my mind: (one) mathematical statisticians and mathematicians draw heavily and sometimes disastrously from each other's ranks, (two) the critical shortage of the various types of statisticians can be somewhat eased as undergraduate and graduate students majoring in such subject matter fields as economics or engineering find it to their advantage to take several courses in statistics. Such knowledge may help them in the future in knowing when it is necessary to consult scarce and overworked talent and when they can "do it themselves."

Donald C. Riley
Executive Director
American Statistical Association

FROM THE STANDPOINT OF COLLEGES

T. A. Bancroft
Iowa State College

Introduction

The present and anticipated extreme shortage of able statisticians to fill academic positions in teaching, research and consulting is, of course, part of the general growing dilemma in higher education. The overall situation is spelled out in the recent report of the President's Committee on Education Beyond the High School. To quote from an editorial in the August 19, 1957 issue of the Washington Post:

> Whatever complacency still exists in regard to higher education in the United States ought to be shattered by the report of the President's Committee on Education Beyond the High School. The gist of this group's finding is that we are in an "explosive" period—population-wise and in the expansion of knowledge—and that the resources to meet the new demands for education are not at hand.
>
> Most critical of all the deficiencies is the shortage of qualified teachers. Theoretically the number of college teachers available could be doubled in the next 10 to 15 years, but this would require a strong attraction to education as a profession. Yet there is no such incentive. The Committee finds that faculty salaries must be increased by 75 to 80 per cent to make them even competitive with other positions in the professional labor market.

The field of statistics, however, is in a particularly desperate situation due to the fact that it is academically a relatively new discipline which at the same time finds itself in an "explosive" period of development. For example, during and subsequent to World War II, industry, public health and medicine have discovered the importance of statistics as a tool of research and management.

Competition by government agencies, industry and the universities for the limited number of students being trained in the few established university departments of statistics has reached an all-time high yet still mounts. Since even in competition for their own staff the universities can be outbid by outside agencies, some devices must be found to retain able statisticians in academic positions so as to increase the supply of statisticians available to all.

Appraisal of New Academic Positions Currently Being Created

Many colleges and universities, including the smaller ones, are introducing new basic courses in the principles of statistics, statistical methods, and statistical theory. If all these courses are to be taught by trained statisticians, this demand alone will create many new academic positions in statistics. Again, an increasing number of strong universities are establishing separate departments of statistics and statistical laboratories which call for additional staff trained in statistics. In that connection, I believe that the year 1957 marks the date when statistics, as a separate discipline, may be said by some to have attained the ultimate in respectability in the United States, for this year Harvard University is establishing a separate department of statistics under their Faculty of Arts and Sciences.

Colleges and universities need additional consulting statisticians to work with research scientists in designing and analyzing investigations. In particular, agricultural experiment stations, schools of public health, medical schools, engineering experiment stations, and other academic research institutes are searching desperately for able consultants in statistics. Additional demands for statistically trained staff in the universities are being

stimulated by the recent developments in high speed computing. Especially is this so in institutions providing campus-wide computing services to research workers through already established statistical centers or laboratories.

Furthermore, the United States has a responsibility to provide academic statisticians to train foreign students both at American universities and at statistical training centers—which may be of either temporary or permanent nature—established in economically underdeveloped regions of the world. It is of great importance that the central statistical offices in such regions concerned with censuses, surveys, agricultural estimates, etc., be adequately staffed to furnish accurate information on economic and social matters.

Possible Sources of Supply of Statisticians

In the long run, the combined efforts of "older" collegiate departments of statistics and the new units mentioned earlier or right now in the planning stage should *eventually* cope with the demand, provided that a strong attraction to higher education as a profession makes possible retention of enough able statisticians to do the job. Dedication, though important, may not be enough. The positions themselves should be made more attractive. While university salaries have been rising, they must go higher, to levels more nearly comparable with those in industry. It will be necessary to increase fringe benefits such as are provided to other professional workers. Congenial and pleasant working conditions (including adequate office space for consulting and research) should be made available. Industry, and government itself, could help support the statistical programs at universities by establishing more scholarships and fellowships and by supporting contractual research at the universities. The more intangible advantages of an academic career should be pointed out to able young statisticians, e.g. an intellectual environment, security, and freedom to engage in independent research.

For the short-run period the universities must face the shortage of academic statisticians and attempt to make efficient use of those available. Research workers in the various substantive subject-matter areas, who have relied heavily on the statistician to design and analyze their investigations, should be trained to act as their own consulting statisticians on all but the more difficult problems. This can be done in regular service courses provided by the statistics staff or in special short courses and eliminating duplicative offerings such as are common at the elementary level on many campuses. In some instances such consolidation and elimination can best be done by centralizing the teaching of statistics. This may make feasible a stronger vertical development in course offerings in statistics as well as a horizontal emphasis.

It may be possible to attract able young mathematicians to mathematical statistics as a field and university teaching and research as a career. On the other hand, individuals from substantive subject-matter fields who have aptitude for and interest in statistics may become interested in further preparing themselves for academic positions in statistics. Finally, there is another, relatively untapped source of supply—which may be especially valuable to smaller schools with limited budgets for expanding their statistics programs. I have in mind a group of able and inquisitive older persons now holding advanced positions in industry, nonacademic research or government who could be interested in part-time or full-time academic positions and who already have both considerable experience in fields other than statistics and an informed interest in applications of statistics.

Possibly a quick upgrading in the quality of the teaching of present college statistics courses—in particular those being taught by staff whose graduate major training was not in statistics—could be effected by establishing several summer institutes especially for teachers of statistics. Perhaps such a proposal might find support from a foundation interested in the promotion of higher education in the mathematical sciences.

FROM THE POINT OF VIEW OF THE FEDERAL GOVERNMENT

David L. Futransky
Bureau of the Census

There are now about 2100 persons in the Federal service classified as Statistician. Their positions are broken down into four functional groups: Analytical, 62 percent; Survey, 15 percent; Statistician, which cuts across both Analytical and Survey duties, 15 percent; and Mathematical, 8 percent.

These jobs tend to be concentrated in the Defense Department, Departments of Agriculture, Commerce, Health, Education and Welfare, Labor, and, most recently, Treasury. The location of the positions has a direct bearing on the problem of future requirements since the extent to which these particular agencies expand or contract their programs will largely determine the Federal Government's need for Statisticians.

Present Demand for Statisticians

In a nation-wide survey of all agencies made in June 1957 by the Civil Service Commission, a total of about 280 vacancies were reported in grades GS-5 to GS-12. Adding to this the number of requests received for posi-

tions above GS-12, 300 would be a generous estimate of the total number of vacancies of all types of statisticians at all grade levels. Of these 300, perhaps 40 to 50 would need a substantial amount of mathematics and statistics to qualify as Mathematical Statistician, or handle the more statistically complex Analytical-type positions.

Supply

The basic source of supply for persons for career-type appointments is, of course, registers established through the examination system of the Civil Service Commission. Entrance grades GS-5 and GS-7 are covered by the Federal Service Entrance Examination. (This is the examination which has replaced the old Junior Professional Examination.) Grades GS-9 and above in the Washington area are serviced by the Board of Civil Service Examiners at the Bureau of the Census.

The Federal Service Entrance Examination has not been able to provide sufficient eligibles to meet agencies' needs for Statisticians at the GS-5 and GS-7 levels. It appears that the Federal service is unable to attract to the examination, people who both meet qualification standards for Statisticians and who are interested in working for the Federal Government.

At grades GS-9 and above, the problem is twofold: (1) short supply of eligibles in certain subject-matter areas; (2) quality of eligibles. A shocking shortage is clear from the fact that there are no more than a half-dozen persons on the registers for the Washington area who qualify as Mathematical Statistician. The supply is not much better in the Analytical and Survey registers for persons with backgrounds in such fields as Demography, Health and Medicine, Physical and Biological Sciences. To add to the problem, the registers are made up for the most part of people already in the Federal service. In other words, of the approximately 320 persons on the registers, 75 percent are working for the Federal Government. The examination, therefore, acts more as an internal promotion device, shifting people around, in and between agencies, with no new people coming in at the bottom. As to quality, some 215 certificates for positions in grades GS-9 and above have been issued in the past year, from which only 25 percent resulted in appointments. There is good reason to believe that for the most part, the certificates were returned unused because it was felt that the persons available for appointment were not adequate for the job.

What is being done to close the gap between Supply and Demand?

The competition for persons trained in mathematics hardly needs elaboration. Persons so trained are wanted for both Mathematician and Mathematical Statistician jobs and until more people are available, the problem becomes first a matter of striving for a reasonable allocation between the two kinds of jobs. The picture is complicated by salary. Until December 1957, the Civil Service Commission had provided higher entrance salaries for Mathematicians in the GS-5 to GS-11 grades, but not for the Mathematical Statisticians at these grades. However, effective December 1957, the same salary adjustments were applied to the Mathematical Statistician. Removing the pay differential between Mathematician and Mathematical Statistician was a must. This has at least removed an artificial barrier within the Federal service. Any future salary adjustments for higher grade Mathematician positions should, of course, apply equally to the corresponding Mathematical Statistician grades, or the situation will be right back where it started.

While no one expects any spectacular increase in the number of degrees in mathematical statistics in the near future, there are graduates with Bachelor's or Master's degrees in mathematics who are both willing and able to work into trainee positions as Mathematical Statisticians. If they would be given on-the-job training and encouraged to take advantage of statistics courses available in many larger universities, there is little doubt they would develop into effective Mathematical Statisticians. Many with similar backgrounds have already done this.

The situation is better for the Analytical and Survey Statisticians. There are some immediate steps that can be taken to improve their supply. First, salaries at the entrance grade must be adjusted so that they are competitive with salaries outside the Federal service. Present starting salaries of $3670 per year at the GS-5, and $4525 per year for the grade GS-7, are low for the qualified college graduate, compared to what he is offered outside the Government for many kinds of jobs. And if the qualified graduate can get a better salary outside the statistical field, he will take it, leaving the field poorer one potential Statistician.

The Civil Service Commission now has under consideration a proposal to adjust salaries for statisticians at the entrance grades—a proposal which, if approved, will help to attract qualified persons to the Federal service and keep them in the statistical field.

Another way of increasing the supply of Analytical and Survey Statisticians is to modify their training by adding one to three courses in mathematics and statistics. These courses given to students majoring in such fields as economics, sociology, engineering, agriculture, etc., will increase appreciably the supply of qualified junior grade Analytical and Survey Statisticians.

These few additional courses are important because the GS-5 grade has a mandatory educational requirement of 15 semester hours of mathematics and statistics, of which at least six must be in statistics. This 15-hour requirement is the biggest obstacle to qualification since apparently few schools require an economics major, for example, to take as much as 15 semester hours in mathematics and statistics.

Future Needs

It is difficult to foresee any extraordinary increase in the size of the Federal statistician group in the next few years. Except in an agency like Census, where statistics is its business, a relatively small professional staff of Statisticians can serve the statistical needs of most agencies.

The growing awareness of the contribution that modern statistical methods can make in attacking problems in many areas of research will lead, I think, to greater use of such small highly-trained staffs. Whereas, at present, mathematically trained statisticians make up about 8 percent of the statistician group, this proportion may therefore grow substantially, if they can be found, even though the overall size of the entire statistician group does not show any great increase.

In relation to all persons using statistical methods, the number of persons classified as statisticians is probably quite small. For example, there are Economists, Logistics Specialists, Research Analysts of all types, Scientists and Engineers, and others who work in areas where quantative thinking is taking on an increasingly important role, and who must make use of statistical methods as a tool in carrying out their subject matter functions.

It may well be that if such people were given additional statistical training—without attempting to make them statisticians as such—they would be equipped to handle certain of their statistical problems themselves, or would be able to make effective use, on a consultant basis, of the statistical specialist. Such an approach would tend to increase the need for statistical training but would lessen the need for large scale increases in the number of positions classified in the Statistician series.

A SURVEY OF BOTH INDUSTRY AND COLLEGES

Boyd Harshbarger
Virginia Polytechnic Institute

A survey by the Department of Statistics of the Virginia Polytechnic Institute was made in the year 1957 on the demand and supply of statisticians now and ten years hence for a legislative committee of Virginia.

The Department of Statistics of the Virginia Polytechnic Institute requires of their Masters and Ph.D. candidates rigorous training in statistical theory, in mathematics, and in methods related to an applied field. This program is somewhat different from many of the existing programs in statistics. In order to be precise in our description of the statistical program concerned in the survey, the colleges, industries, and government agencies were asked to comment specifically about the demand and supply of statisticians with training similar to that given by the Virginia Polytechnic Institute. A version of the replies from these groups is listed under the various types of organizations in the next few paragraphs.

A State University in the South

"A severe shortage of qualified manpower now exists in the field of statistics, and appears to be growing. This is true both in theoretical and in applied statistics, and includes the kind of people you are producing at the Virginia Polytechnic Institute. It has become clear today, from the many requests to recommend statisticians and the small number of qualified individuals available, that this shortage is severe in all three of the fields of government, collegiate, and industrial employment. No one can predict, in great confidence, what will appear ten years hence, but the indications are strong that we will still have a shortage, probably a severe one, of highly qualified statisticians."

A Land Grant College in the Midwest

"The shortage of statisticians might best be illustrated by the fact the National Bureau of Standards itself appears to be interested in hiring as many statisticians as will probably be available to the entire government. As the complexity of modern government activity increases one may expect the demand for statisticians to also increase. There is no indication that the supply of statisticians for government service will significantly increase over the next ten years. It appears that almost every college or university in the country that engages in research activity is interested in augmenting its statistical staff. The large amount of defense activity in industry has created a large demand for statisticians. The salary of statisticians in industry is quite comparable to that of the engineer with perhaps the Ph.D. statistician having a little edge over the Ph.D. engineer."

A Private University in the East

". . . there is plenty of evidence that such a shortage does exist. The shortage which now exists is probably worse than it has been at any time since the war. I expect the shortage to get worse before it gets better. Salaries for statisticians at the Ph.D. level in industry are at about the same level as they are for engineers."

A Northeastern State University

The shortage in Statistics is as serious as that in any other field and possibly even more serious than that which we find in such areas as Chemistry and Mathematics. In view of the rapidly expanding areas in which statisticians are being used, I believe the shortage will become increasingly serious."

A Land Grant College in the South

"There is a great shortage of well-trained statisticians who are taught how to use the theory. We could produce five times as many M.S. and Ph.D. level statisticians and not swamp the market in ten years. The recognized need is being expanded much more rapidly than production. An engineer who also has statistics training can be assured of $1,000 higher starting salary. An equally qualified statistician can easily secure $100 per month more than the same level engineer. This does not apply to nuclear engineers."

A Pharmaceutical House

"There is a definite shortage of well qualified applied statisticians at the starting levels of employment. This corresponds to a general shortage of scientific personnel but is greater because of increased demand for statisticians while a very limited number are being trained."

Large Industry in New York

"The prospect is that this shortage will continue for a considerable number of years. There does seem to be an increased interest in training of statisticians, but I do not believe that this is now keeping pace or is going to keep pace with the increased demand unless something drastic occurs."

A Large Manufacturer of Radio, Etc.

"I feel that a shortage exists of statisticians trained in the field of stochastic processes. There is a shortage which is not quite as serious in the field of experimental design and theory of quality control, particularly coupled with practical experience. Statisticians seem to receive salaries commensurate with engineers on the same level of experience."

A Large Electrical Corporation

"There is definitely a shortage of well trained statisticians. I should say that the scarcity is critical here too. Once an industrial concern decides that statistics can be profitable, it is apt to immediately decide to employ from 6 to 20 statisticians."

A Large Electrical Company

"There is a shortage of statisticians in the industrial field, particularly men who can apply statistical methods with a degree of realism, practicability and imagination. There is a very great demand for experts in the field of experiment design and numerical analysis. Although I would hesitate to predict the prospect ten years from now, I should certainly say that our present shortage will last another five years. As far as this firm is concerned, the salary for statisticians is equal to that paid for engineers. In fact, a statistician with some experience can come in with as high if not higher salary, depending on the situation, as that paid to an engineer of comparable experience."

A National Laboratory

"With respect to government and college employment there exists a serious shortage of adequately trained statisticians. Ten years from now I have hopes that we will have done a great deal to alleviate the shortage. As I see it, this must come not through the continuous expansion of existing facilities for training statisticians but rather through the establishment of new centers at other universities."

A Large Soap Company

"There is a substantial shortage of men trained in experimental statistics. As evidence of our concern, to meet a need for one Ph.D. statistician, we have embarked on a program of recruitment at a number of colleges and a program of advertising for experienced statisticians. We are also considering the possibility of European recruiting."

An Engineering Corporation

"There is a definite shortage in the field of statistics, particularly the type of statistics given at Virginia Polytechnic Institute, in government, college, and industrial employment. In addition, I believe this shortage to be greater than that in any other field insofar as industry is concerned and probably almost as bad in the government and at the college. To be specific, within our firm, there is an immediate need for at least 15 competently trained statisticians. When one considers that no more than 30 to 40 people of this caliber are graduated in one year in the U. S., then the shortage is readily apparent. Industry in the Pittsburgh area alone could more than handle these and then some. In industry, the prospect of this shortage ten years from now is on the gloomy side. Personally, I do not see how the situation will ever improve. In industry, salaries in the statistical field are, in general, higher than those in the engineering fields with the difference being from $10 to $50 per month, or $100 to $600 per year."

A Government Proving Ground

"There is definitely a shortage of the type of statistics that you are giving at Virginia Polytechnic Institute, since no matter what organization I come in contact with there is a shortage of appropriately trained statisticians. Moreover the demands for statistical applications have been ever increasing over the past years. Industrial salaries for both statisticians and engineers are approximately one and one-half to twice that for government employees."

STANDARDS OF PROBABILITY SAMPLING FOR LEGAL EVIDENCE

W. EDWARDS DEMING

Graduate School of Business Administration New York University

These STANDARDS have appeared as a special report from The Society of Business Advisory Professions. They had their origin in the need expressed by the lawyers and accountants of that Society for an authoritative statement that would dispose of the question that often comes up on whether data obtained by a sampling survey are admissible as evidence. The answer contained in the STANDARDS places the test of acceptability squarely where it belongs: (1) on the equal complete coverage, the question being whether, had the study been an equal complete coverage, would it have been acceptable as evidence? (2) on the question of whether the sample was a probability sample; (3) on the precision, as measured by the standard errors; (4) on the magnitudes of the nonsampling errors, these being common to both samples and complete coverages.

These STANDARDS establish specifications for sampling, which if certified as followed, and provided the standard error of the sample-result is small enough to be innocuous, and provided its interpretation takes account of the number of degrees of freedom if small, and of extreme skewness in the frame, if it exists, should establish the acceptance of the numerical result of a sample as legal evidence on the same status as the result of an equal complete coverage of all the units in the same frame whence the sample came, without the requirement of a dissertation on the theory, techniques, meaning, and reliability of sampling.

Questions on the usefulness of the data, the date of the survey, the procedure of interviewing or of testing, and the decision on whether a proposed frame covers adequately the universe that one really wishes to study, are the same whether the study will be a complete coverage or a sample, big or little. These questions are not solved by statistical theory, but belong to the realms of subject-matter, law, and administration. A careful statistician will of course satisfy himself on these points; else the results may lack utility. Standards and codes define responsibility; not ways in which the statistician and the expert in the subject-matter work together.

A new concept in the STANDARDS is the equal complete coverage, defined as a coverage (a 100% sample) of all the sampling units in the same frame as was used for the sample, under the stipulation that the complete coverage be carried out with the same procedure as was used for the sample for eliciting the information, with the same definitions and with the same care and over about the same period of time.

The sample contains omissions, nonresponse, correct response, and wrong response, in about the same proportions as would be found in the equal complete coverage.

The sample comes from the frame. Objective statistical inferences from the sample refer only to the frame; not to the universe, unless the frame covers the whole of the universe.

The standard error measures the margin of difference, for a stated probability, between the equal complete coverage and the result of a sample. The outside margin of difference between the result of the equal complete coverage and an estimate made from a sample thereof is 3 standard errors of the estimate. The actual difference is usually within 2 standard errors, and may lie in either direction. One must however take care in this interpretation to make proper correction if the number of degrees of freedom in the estimate of the standard error is small, and must make further correction by the proper theory if the populations of the sampling units in the frame show extreme skewness.

A small standard error means that an equal complete coverage of the same frame would give very nearly the same result as the sample. It does not mean that the data will be useful, nor that the field-work was carried out expertly, nor that the responses were accurate, nor that the problem of nonresponse was conquered.

Random drawing implies the use of random numbers for the selection of the sampling units from the frame. There exists today no other satisfactory operational definition of random drawings.

The STANDARDS make the important point that once the standard error of a result is estimated by a valid procedure, and if it is interpreted with due regard for the number of degrees of freedom, and with further regard for extreme skewness if it exists, the details of the sampling plan add no new information concerning the margin of sampling error. This statement should be of special interest in marketing research, where clients often specify needlessly and often inexpertly the size of the sample and the procedure of sampling, when their real concern should be the standard error or the amount of information desired for some of the results of chief importance. It should also be of interest to marketing research companies themselves, which often present to their clients not only the standard error but the procedure of sampling as well, as if the procedure added something to the standard error.

Actually, what is really important, other than the standard error, is an evaluation of the nonsampling errors.

The statistician's testimony or exhibits should describe:

a. The results of measuring (by means of a sample of the main sample):

i. the proportion of failures to cover the sampling units properly and in the manner prescribed;

ii. the proportion of sampling units not intended for the sample but covered or partly covered by mistake;

iii. the errors and difficulties in reporting;

iv. nonresponse;

v. other slips and blemishes in the execution of the sampling procedure;

b. The possible effects of the nonsampling errors on conclusions drawn or to be drawn from the data.

c. Skewness and rare populations in the material sampled (e.g., the discovery of a huge account in the sample from a stratum of small accounts; areas of heavy growth that appear in the sample); and their possible effects on the results and on the estimates of the standard errors, and on the interpretation thereof.

A sample-design may be valid though inefficient. Validity and efficiency are unrelated. A standard error, once valid, retains its validity and interpretation even though some other method of sampling, known today or to be discovered tomorrow, turns out to be more efficient than the plan actually used.

The impact of these STANDARDS on statistical practice will be felt over a long period of years. Two important results will eventually be (1) a clearer understanding of the strength and of the limitations of statistical theory and of subject-matter; and (2) a clearer statement of the responsibilities of the statistician and of the expert in the subject-matter, or the management.

Copies of Issue No. 26 of Current Business Studies, which contains the STANDARDS, may be obtained from The Society of Business Advisory Professions, Inc., Gallatin House, 6, Washington Square North, New York 3. The price is $1.50 per copy.

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QUESTIONS AND ANSWERS

Edited by ERNEST RUBIN
U. S. Department of Commerce
and American University

The Edge of Familiarity

In the June 1957 issue I briefly discussed the importance of the initiative in areas of competition and how statistical data of master chess play could be tested with regard to this factor.[1] I now consider a related element that is significant in competition, namely familiarity with the locus of the action.[2]

Intuitively we feel or sense that in a contest there is an important advantage in being on home ground. Commonplace examples from varied activities may be cited. The legal profession, where the activity relates to the courts, provides several instances and two may be noted. In trying a case an attorney will arrange, if possible, to have the case go before a court where previous views expressed by the court on similar cases are available and favorable to his side. In general, lawyers prefer to try cases in their own counties and states because of a familiarity with local procedures and with local feeling.[3] In golf tournaments the professional of the club sponsoring the competition has a definite advantage over visiting competitors because of his detailed familiarity with the terrain. Similarly in certain types of military operations the defenders on home grounds have the advantage of familiarity with the total complex constituting the locus of the action. The Russians in the Napoleonic war and in World War II exploited these advantages. A special understanding of the terrain and of the weather by the Russians was part of the familiarity with the locus of the action.

In various sports athletes encounter important handicaps when playing on their competitor's field. Track men, for example, are sensitive to variations in the shape and texture of the tracks. These handicaps apply to team and individual play and performance.

An interesting and valuable source of statistical data on games played at home and away is supplied by major league baseball.[4] These data[5] may be examined, using the normal distribution test of significance for the difference of two sample proportions.[6] Each team in the major league plays as many games at home as away. It should be noted that in the major leagues no two playing fields are identical in size, shape or soil.

Table 1 gives data on pennant-winning teams in the American League which show games won at home and away during the ten year period 1947-1956. Applying the test for the difference of two proportions to .68 and .60, representing the respective proportions of games won at home and away, yields a significant result at the one

Table 1. Games Won at Home and Away by Pennant-Winners in the American League: 1947-1956

	Performance of Pennant Winners			
Place of Performance	Games Won	Games Lost	Total Games	Games Won ÷ Total Games
At home	525	247	772	.68
Away	460	306	766	.60
Total	985	553	1,538	.64

percent level.[7] A similar result is obtained for the National League pennant winners; the data for this group are shown in Table 2.

Table 2. Games Won at Home and Away by Pennant-Winners in the National League: 1947-1956

	Performance of Pennant Winners			
Place of Performance	Games Won	Games Lost	Total Games	Games Won ÷ Total Games
At home	509	261	770	.66
Away	451	319	770	.59
Total	960	580	1,540	.62

Consider now the teams that achieved second place during this period. The results, regarding games at home and away, vary somewhat from those obtained for the pennant-winning teams. In the American League, the second place teams were comparatively weaker away from home than the pennant winners. As shown in Table 3 the spread between games won at home and away is

Table 3. Games Won at Home and Away by Second Place Teams in the American League: 1947-1956

	Performance of Second Place Teams			
Place of Performance	Games Won	Games Lost	Total Games	Games Won ÷ Total Games
At home	516	258	774	.67
Away	418	349	767	.54
Total	934	607	1,541	.61

98 games and in terms of the test, the difference between the proportions, .67 and .54, is extremely significant.[8] In

the National League the second place teams, while favored at home, did not achieve statistically significant differences on this point. The data given in Table 4 when tested, yielded a result that is not significant at the 5 percent level.

Table 4. Games Won at Home and Away by Second Place Teams in the National League: 1947-1956

	Performance of Second Place Teams			
Place of Performance	Games Won	Games Lost	Total Games	Games Won ÷ Total Games
At home	471	299	770	.61
Away	438	335	773	.57
Total	909	634	1,543	.59

Roth observes that "Overall figures for both leagues during the past ten seasons (1947-1956) show that the home clubs have played .537 ball."[9] There are 16 teams, each playing 154 games or a total of 2,464 games a season. In theory a total of 24,460 games are completed in 10 seasons; the actual number of games, however, is slightly less because of cancellations and ties that are not played off. On the assumption that the probability of winning is equally likely at home or away, i.e., a proportion of $p = .5$, the standard error of a proportion for a sample of size $N = 24{,}460$ games is about .003. The test for the difference of the two proportions, $\frac{.537 - .500}{.003} = 12+$, gives a result that is extremely significant.

It seems worthwhile and interesting to explore other sports and competitive activities from the standpoint of statistically demonstrating the importance of familiarity with the locus of the action.

Notes

1. For a criticism of the findings see the letter by Professor Hussain in the *Questions and Answers Correspondence* section in this issue.

2. The phrase "familarity with the locus of the action" is defined in the present context to be special or prior knowledge, in the possession of one competitor, of mental, physical, or psychological factors that may influence the outcome of a competition.

3. Northern lawyers who have been called into Southern cases frequently face hostile juries and generally are resented by the local community.

4. The importance of this source for the present discussion should be indicated. Major league baseball is carefully organized with regard to rules and regulations and includes impartial arbiters (umpires) who uniformly and strictly enforce these rules. Thus it is possible to hold or treat as practically constant a group of factors that might otherwise be sources of important variations influencing the results of games.

5. The data used here have been adapted from the article by Allan Roth, "You Have to Win on the Road," *Sport*, Vol. 24, No. 3, September 1957, p. 74.

6. The test is $\frac{x}{\sigma} = \frac{p_1 - p_2}{\sigma_{p'}}$, where $p' = \frac{p_1 N_1 + p_2 N_2}{N_1 + N_2}$

and $\sigma_{p'} = \left(p' q'\right)^{1/2} \cdot \left(\frac{1}{N_1} + \frac{1}{N_2}\right)^{1/2}$

7. $\frac{x}{\sigma} = \frac{.68 - .60}{.024} = 3+$

8. $\frac{x}{\sigma} = \frac{.667 - .545}{.0245} = 5-$

9. Op. cit., p. 74.

QUESTIONS AND ANSWERS CORRESPONDENCE

Sept. 17, 1957

Dear Sir:

I have greatly enjoyed the article entitled "The Significance of the Initiative in Chess" in your publication No. 3, Vol. II, 1957. The conclusions drawn by the contributor are in agreement with expectations from the presumptive knowledge (or assumption) that initiative constitutes an advantage in games of skill. But I think the magnitude of the initiative also comes into consideration.

Can an initiative obtained by having the first move be maintained throughout the course of a game, or can it be exchanged by force with some other form of advantage? I think, it was Tartakower who remarked that the winner of a game of chess is that player who makes the next to last blunder! Though chess is predominantly a game of skill, it may equally well be regarded as a game of blunders of all shades of intensity. In other words, one may say that initiative is an oscillating function taking alternatively positive and negative values.

I agree with the contributor about the complex nature of the study of initiative; and, in fact, think it to be such a confounded business that it is impossible either to isolate the single factor of "the advantage of the move" or to design a balanced experiment with many factors permitting separate evaluation of the effects due to the different factors. Not only are these factors difficult to estimate and allow for, but some of them are actually more important than the effect we seek to assess. This is virtually admitted by the contributor while discussing the results of the Grandmasters' Tournament of 1953: He asserts that there appears to be a greater variation of strength among the players than the difference between the first and second moves. When this is true for a selected group of the Grandmasters, how much more true it must be in general!

My chief objection to the method used by the author is connected with his ignoring the drawn games and considering only the won and lost games. This is tantamount to

throwing away valuable recorded information. The test of skill is reflected in all possible results which are rightly assessed by awarding 1, 0 and ½ points to the won, lost and drawn games, respectively. Drawing is half-winning, and is by no means a mean achievement! Of course, in the instances cited in his statistical analysis, the final conclusions would have remained substantially the same, though the levels of significance would have been less stringent in all cases, had he considered the drawn games in their true status of half-won games. I think, a more relevant criterion for decision of the point at issue would be the number of "points" gained with white pieces rather than the number of games "won."

Capablanca's Hundred Best Games of Chess, The Russians Play Chess, Chess Marches On, My Best Games of Chess, and World's Great Chess Games—or similar compilations—cannot be considered as unbiased samples. Short and brilliant games have a greater chance of inclusion in such treatises. Drawn games and games won by Black tend to be inconveniently lengthy and are therefore usually excluded from such collections. This makes the apparently favorable pictures for White, as derived by the author from an examination of the games included in the above-mentioned collections, rather suspect and statistically invalid.

The long and short of the conclusion boils down to what the author has aptly described as suggestive rather than conclusive. I do not, however, share the author's implied optimism about the future possibility of arriving at a conclusive judgment. It is true that "initiative in chess" leads to quicker and more elegant wins. But "initiative in chess" does not belong exclusively to the first player. (Alekine's Defence has been described as conferring the "initiative" of the defence!) It may be true that the first move has something like 50.05% chance of maintaining the initiative between two "exactly" balanced players. But this may not be sufficient for a win. I think that Tartakower is right, after all, and that a win is as a rule achieved by the gift of the opponent who makes the last decisive slip aided, perhaps, by a last-minute flash of genius of the winner in discovering the winning line!

Yours truly,

Q. M. Hussain
Professor of Statistics
Dacca University
East Pakistan

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NEWS ABOUT MEMBERS

Robert M. Anthony is on leave of absence from Harvard University during 1957-58, helping to start the Management Development Institute, an 8-month Institute for members of middle management of international companies at Lausanne, Switzerland.

Clifford A. Bachrach, M.D., formerly Director of Medical Records and Statistics at Johns Hopkins Hospital and Assistant Professor at Johns Hopkins School of Hygiene, is now Chief, Research Statistics Division, Department of Medicine and Surgery, Veterans Administration, in Washington.

James T. Baird, Jr. has joined the U. S. National Health Survey, Public Health Service, as a statistician on the special studies staff. He was formerly with the Biometrics Division, Office of the Surgeon General, USAF, and before that was a statistical consultant to the Republic of Lebanon and statistician for the Florida State Board of Health.

George W. Brown, who had been with the International Telemeter Corporation, has been made Director of the new Western Data Pocessing Laboratory of the University of California at Los Angeles.

Morton L. Brown, commissioned officer in the Public Health Service, has been added to the staff of the National Office of Vital Statistics, U. S. Public Health Service.

Joseph G. Bryan is now employed as Operations Research Analyst by the Central Research Laboratory, American Machine and Foundry Company.

William G. Cochran has left Johns Hopkins University to accept a professorship in the new Department of Statistics at Harvard University.

Herbert Dagen, formerly Chief of the Quality Evaluation Division, is now Chief of the Statistical Operations Office, U. S. Army Chemical Corps Quality Assurance Technical Agency at the Army Chemical Center, Maryland.

H. A. David was appointed Professor of Statistics at the Virginia Polytechnic Institute beginning November 1957. Dr. David was formerly Senior Lecturer at the University of Melbourne and previously was on the staff of the Commonwealth Scientific Industrial Research Organization of Sydney, Australia.

Jack E. Davis has been elected Vice President—Operations of the Seaman-Andwall Corporation. He joined Seaman-Andwall a year ago as Assistant to the President.

Helen F. Demond has been appointed Chief of the Income, Finance, and Wealth Branch, a new unit of the Statistics Division of the Internal Revenue Service.

Carl H. Fischer, Professor of Actuarial Mathematics and Insurance, University of Michigan, has been named by Secretary of Health, Education and Welfare, Marion B. Folsom, to a 12-member advisory council which is to review the long-range financial position of the Social Security System.

Donald J. Fisk, formerly Mathematical Statistician at the U. S. Naval Proving Ground, Dahlgren, Virginia, is now employed as Senior Engineer by Laboratory for Electronics, Inc., Boston, Massachusetts. His primary assignments are statistical design of experiments, quality control, and life testing.

Richard J. Foote has resigned as Head of the Price and Trade Research Section, Agricultural Economics Division, Agricultural Marketing Service, to join the staff of the Connell Rice and Commission Company in Stamford, Connecticut.

Nathan Goldfarb, former Director of Research at B. C. Forbes and Sons Publishing Company, has been appointed Chairman of the Department of Management and Marketing in the Division of Business at Hofstra College.

Raymond W. Goldsmith has been appointed Ford Distinguished Visiting Professor at New York University, School of Commerce, for the Spring term of 1958. He has also been elected Chairman of the Council of the International Association for Research in Income and Wealth for 1958-59.

William Grodowitz has recently transferred from the Office of Operations Analysis, Hq. Air Proving Ground Command, Eglin AFB, Florida to the Office of Operations Analysis, Hq. USAFE, Wiesbaden, Germany.

Philip Grossman, formerly in the Economic Statistics Branch, Population Division, Bureau of the Census, has transferred to the Central Intelligence Agency.

J. Wayne Hamman is engaged as Statistician for the Inland Testing Laboratories, Morton Grove, Illinois. His work consists of experimental design and data analysis for environmental testing of electronic components.

Wells Harrington has been named Chief of the Research Advisory Service, Research and Statistical Services Branch, Office of Education.

George W. Hervey, one of the founders of the post-war Red Cross Blood Program and its Director of Statistics since it was established ten years ago, retired from Red Cross service on December 31. In 1957, Dr. Hervey acted as consultant to the Joint Blood Council in conducting a national survey of blood usage and collection facilities.

Robert G. Hoffmann has resigned from his position as Statistician for the Commission on Professional and Hospital Activities, Inc., Ann Arbor, Michigan and has accepted an appointment as Statistician for the J. Hillis Miller Health Center and Assistant Research Professor of Statistics, Statistical Laboratory, University of Florida.

Martin M. Horden is working for the General Foods Corporation at their Tarrytown, New York Research Center as a statistician in the Product Evaluation Group.

Theodore W. Horner, formerly Assistant Professor at the Iowa State College, has joined General Mills, Inc. in Minneapolis as Operations Research Analyst, Management Analysis Department.

Keith W. Johnson, Pa-ific Gas and Electric Company, San Francisco, has been named Technical Consultant to the Committee on Economic Policy of the Business Advisory Council for the Department of Commerce.

Saul Kaplan, formerly with the Social Security Administration, has joined the staff of the Statistical Methods Branch, Bureau of the Census.

Frederick G. King, formerly of the Ballistic Research Laboratories, Aberdeen, Maryland, is now Senior Scientist with the Armour Research Foundation of the Illinois Institute of Technology, Chicago, Illinois.

Howard Laitin has been appointed to the faculty of the Army Medical Service School, San Antonio, Texas, as Statistical Officer for the Department of Nuclear Warfare and Mass Casualty Studies. He is currently on military leave from Michael Saphier Associates and S.U.A. of New York, where he served as Director of the Department of Research and Statistics.

Earle H. MacCannell left the University of Washington in Seattle, Washington to take a position at San Diego State College in San Diego, California. Dr. MacCannell teaches courses in statistics in the Departments of Sociology and Economics at San Diego State.

Richard McHugh has resigned as Associate Professor of Psychology and Statistics at Iowa State College to take a permanent position in the Biostatistics Division, School of Public Health, University of Minnesota, where he had previously been Visiting Professor of Biostatistics.

Peter F. Merenda, formerly Research Director, U. S. Naval Examining Center, Great Lakes, Illinois, has accepted a position as Senior Research Associate, Walter V. Clarke Associates, Providence, Rhode Island. He received a Ph.D. degree from the University of Wisconsin in August of 1957.

Pearl Meyer is Director of Research and Records, Handy Associates, Inc., 570 Lexington Avenue, New York City.

Giorgio Mortara has resigned from his position of Technical Adviser, Brasilian Institute of Geography and Statistics, having been appointed Professor of Economic Statistics and Director of the Institute of Demography at the University of Rome.

Charles C. Powell has joined the newly opened Los Angeles office of the Statistical Tabulating Corporation as a Methods Engineer. His primary work will be in the design of statistical, actuarial, and related tabulating procedures as well as coordinating the 650 electronic data processing services of the office.

Anita E. Rapoport, M.D., has left Davenport, Iowa where she was engaged in the private practice of anesthesiology to accept an appointment as Assistant Professor in the Department of Anesthesiology of the University of Illinois College of Medicine and Research and Educational Hospitals in Chicago.

Aaron S. Sabghir has been appointed as Deputy Director of the newly created Office on Construction Statistics in the Business and Defense Services Administration, Department of Commerce.

Louise Sagen, formerly with the Illinois Department of Public Welfare, has been appointed Analytical Statistician in the Office of the Chief, National Office of Vital Statistics, Public Health Service.

Helen E. Scott has recently joined the staff of the Operational Research Section, Tuberculosis Program, Division of Special Health Services, Public Health Service, Department of Health, Education, and Welfare, as an Analytical Statistician.

S. F. Seymour, Assistant Social Scientist with Rand Corporation, has been transferred from the Santa Monica, California office to the Lexington, Massachusetts office.

Henry S. Shryock, Jr., Assistant Chief of the Population Division, Bureau of the Census, reported on October 15, 1957 for a six-month assignment with the Demographic Teaching and Research Centre in Bombay. The Centre opened earlier this year under the joint auspices of the United Nations and the Government of India, and will provide training for Fellows selected from the countries throughout Southeast Asia.

Mapheus Smith, formerly with the Technical Services Corporation in Philadelphia, has joined the Research Advisory Service, Research and Statistical Services Branch, Office of Education, as a program analyst.

Morris J. Solomon has been appointed analyst in the Operations Research Group of Atlas Powder Company's Economic Evaluation Department. Mr. Solomon had previously been a senior research analyst with the American Greetings Corporation.

Julian C. Stanley has been appointed Professor of Education at the University of Wisconsin.

Donald W. Stilson is an Assistant Professor in the Department of Psychology, University of Colorado.

Edward P. Swan has returned to the Census Bureau from Iran, where he was Statistical Advisor to the Government on the first national census of Iran, to head the Offshore Areas Statistics Branch of the Population Division. This Branch is responsible for planning and conducting the 1960 census of Alaska, Hawaii, Guam, American Samoa, Puerto Rico, Virgin Islands, the Canal Zone and miscellaneous Island possessions.

Granville Sylvester has transferred from the Morbidity Analysis Section, N.O.V.S., Public Health Service, to the Medical Statistical Division of the United States Air Force.

P. C. Tang has been transferred from the FAO Mission in Ecuador to work for the Government of Peru. He continues to hold the position of Agricultural Statistician of the Food and Agriculture Organization of the United Nations.

Daniel Teichroew has joined the faculty of the Graduate School of Business at Stanford University. He will teach courses in the use of electronic data processing equipment and management service techniques and do research in management decision-making.

Earl A. Thomas has accepted a position as Technical Advisor to the Manager, Ballistic Missiles Division, Burroughs Research Center, Paoli, Pennsylvania.

Maurice D. VanArsdol, Jr., has accepted a position as Assistant Professor of Sociology at the University of Southern California, Los Angeles, California.

Pearl A. Van Natta, formerly with the Denver Research Institute, has accepted a position with the Child Research Council in Denver as a Biostatistician.

Harvey M. Wagner's new appointment is Assistant Professor of Industrial Engineering and Statistics at Stanford University.

Martin Wilk has left Princeton University to become a member of the technical staff of Bell Telephone Laboratories, Inc. at Murray Hill, New Jersey. He is engaging in research in experimental and mathematical statistics, consultation on design and analysis of experiments, and application of highspeed computing to statistical analysis of data.

James Howie Wilson has been appointed Acting Chief of the Income and Wealth Section, Income, Finance and Wealth Branch, Statistics Division, Internal Revenue Service.

CHAPTER NOTES

Albany

William R. Leonard, Past President of the American Statistical Association and Director of the Statistical Office of the United Nations, was speaker at the November 13th meeting. Dr. Leonard's subject was, "Statistical Problems in Other Nations." The usual informal dinner was held prior to the meeting.

The subject at the December 10th meeting was LIFE Magazine's study of consumer expenditures. The speaker was Orlan Gaeddert of the Market Research Department, LIFE Magazine. Mr. Gaeddert discussed the methodology employed and the type of information gathered, new techniques developed during the study, and some of the applications of this study.

Central New Jersey

The Chapter held a meeting on November 27th in Fine Hall, Princeton University, at which Martin B. Wilk, retiring President of the Chapter, was the principal speaker. The subject of Dr. Wilk's presidential address was "Empirical Models." At the business meeting, new officers for 1957-58 were elected. They are as follows:

President—WILLIAM B. SCHRADER
First Vice President—
FRANK J. ANSCOMBE
Second Vice-President—
GLADYS ELLSWORTH
Secretary-Treasurer—
NORMAN FREDERIKSEN
Asst. Sec.-Treas.—KATHERINE MULLIGAN

Chicago

Sir Ronald A. Fisher, Professor of Genetics at Cambridge University, was the speaker at a joint dinner meeting of the Chicago Chapters of the ASA, the American Society for Quality Control, and the American Marketing Association on December 5th. Sir Ronald, who has vastly influenced the development of statistical theory and scientific experimental techniques, spoke on one of the subjects to which he has made a major contribution—"Design of Experiments". He was introduced by Father Peters of Loyola University, who received his doctorate at Cambridge.

A joint luncheon meeting with the Chicago Chapter of the American Marketing Association was held on November 7th, at which David K. Hardin and Dr. Morris J. Gottlieb, both vice-presidents of Market Facts, Inc., discussed the subject, "How Reliable are Product Tests?" On November 21st, Harold M. Finley, Investment Officer, Chicago Title and Trust Company, spoke before a luncheon meeting on, "The Dow Theory—Oracle or Snare?"

"Economic Forecast for 1958" was the subject of a joint luncheon meeting with the Chicago Chapter of the American Marketing Association on December 5th. The panel consisted of three outstanding economists—James Lorie, Associate Dean of the School of Business of the University of Chicago; Beryl W. Sprinkel, Chief Economist, Harris Trust and Savings Bank; and John K. Langum, President of Business Economics, Inc. and a former Vice-

President of the Federal Reserve Bank of Chicago.

Cleveland

Chapter officers for 1957-58 are:
President—DAVID FRAZIER, Standard Oil Company of Ohio
Vice-President — ARTHUR S. LITTELL, Western Reserve University
Secretary - Treasurer — CHARLES H. JOSEPH, JR., American Greetings Corp.

Dayton

The first bi-monthly meeting of the Dayton Chapter for the current program year was held on September 26th at the University of Dayton. Dr. Leon Harter gave a brief report on his attendance at the National ASA Convention. Mr. Ronald Wiley of the Operations Research Staff, Owens Corning Fiber Glass Company, was guest speaker. He spoke on "The Use of Monte Carlo Techniques in Inventory Problems."

On November 5th, the second meeting of the Chapter was held at the University of Dayton with Dr. L. G. Mitten of the Department of Industrial Engineering, Ohio State University, as guest speaker. Dr. Mitten addressed the group on "Queuing Theory Applied to Inventory Problems."

Attendance at both these meetings has been very encouraging and it is hoped that it will continue so throughout the program year.

Denver

Churchill Eisenhart, Chief of the Statistical Engineering Laboratory, National Bureau of Standards, Washington, D. C., and a Vice-President of the American Statistical Association, was the speaker at the dinner meeting of November 4th. Dr. Eisenhart's subject was "The Umbrella Grows Bigger: The Changing Needs, Requirements, and Opportunities that Face the Association". He traced the development of statistics and the American Statistical Association. In 1948, a new constitution was adopted and the Association became an "umbrella society", with members, chapters, sections and associated and affiliated societies. Dr. Eisenhart stressed the importance of a close working connection between the national society and the chapters and sections. He concluded by suggesting some unfinished business—development of a manual on practices and procedures and establishing and developing the role of professional statisticians.

At the December 5th dinner meeting, M. Moinuddin Siddiqui, Mathematical Statistician at the Boulder Laboratories of the National Bureau of Standards, spoke on "The Effect of Serial Correlation on Least Squares Estimates". Dr. Siddiqui described the origin of the least squares method and discussed its uses. He pointed out that in using the method to estimate 'true' quantities or relationships when individual observations are subject to error it is usually assumed that the error in each observation is independent of the errors in other observations. Dr. Siddiqui showed some cases in which the conclusions—the variances of estimates in particular—are altered under serial correlation.

Detroit

On November 14th, the Chapter heard Dr. Herbert W. Robinson, President of the Council for Economic and Industry Research, Inc., discuss "Input-Output Analysis Applied to Business Problems". Among these business problems are production scheduling, decisions on adding new capacity, investment problems, and location of new plants. The guest chairman of the meeting was Dr. Wallace W. Gardner of the School of Business Administration, University of Michigan.

Hawaii

At the November meeting the president appointed a committee to consider the possibility of establishing a coordinated group from social science associations, which would choose research projects, obtain funds from local and national sources, select qualifying personnel to conduct the studies and approve their completion. The speaker was Dr. Robert H. Ruffenburg, Department of Mathematics, University of Hawaii, who discussed "Mathematical Statistics and the Function of a Mathematical Statistician".

At the December meeting Fred Colland, John Child & Co., announced the completion of the 1957 estimates of population and housing data from the 1950 census material. These data were obtained for the essential use of the Bureau of Health Statistics in the Health Department of the Territory. Robert Schmitt, City's Redevelopment Housing Agency, was in charge of obtaining this intracensal information.

The Chapter's officers for the 1957-58 year were elected. They are:

President—CHARLES F. CONGDON, College of Business Administration, University of Hawaii, Honolulu
First Vice-President—GORDON FRAZIER, Analytical Statistician, Bank of Hawaii, Honolulu
Second Vice-President—PAUL T. TAJIMA, Market Research Analyst, John Child & Co., Honolulu
Secretary - Treasurer — (MRS.) LOUISA FRANZEN, Consultant, Honolulu

The meeting was then turned over to Charles G. Bennett, Chief of the Bureau of Health Statistics, Territorial Department of Health, who outlined plans for the Oahu Health Study. He then introduced Mr. George St. J. Perrott, Chief of the Division of Public Health Methods, U. S. Public Health Service, whose talk was the "National Health Survey", which is a Federal source for metropolitan area studies. With Federal money and local contribution, the plan is to use the same method as that for the mainland reports. After the talk, there was discussion about divergences between the Hawaiian and continental population.

Milwaukee

The first lecture-meeting was held on October 15th, 1957. Dr. Carl F. Noble, Manager of the Customer Acceptance Department, Kimberly - Clark Corporation, spoke on "Linear Programming".

The second meeting, a public lecture sponsored jointly with the Milwaukee Section of the A.S.Q.C., was held on October 28th at Marquette University Medical School Auditorium. A distinguished guest, Sir Ronald A. Fisher, Professor of Statistics and Head of the Genetics Department, Cambridge University, spoke to an audience of over 400 people on "The Semantic Nature of Probability".

At the annual dinner-meeting held December 4th, a distinguished demographer, Dr. Bruno De Finetti, Professor at the University of Rome, and Visiting Professor at the University of Chicago, presented a paper on "The Process of Extinction of a Population".

The newly elected officers for 1958 were installed. They are:

President—J. RAYMOND HELBERT, Chemist-Statistician, Red Star Yeast and Products Co.
Vice-President—JAMES B. SCHULTZ, Management Statistician, Milway Incorporated
Secretary-Treasurer — DR. NORMAN J. KAYE, College of Business Administration, Marquette University
Recording Secretary—DR. JOSEPH W. MCGEE, Department of Sociology, Marquette University

Montreal

The first two meetings of the 1957-58 year were devoted to economic statistics. On October 9th, Mr. T. M. Brown of the Department of Trade and Commerce of the Federal Government presented a very interesting talk on "The Econometric Approach to Short-Term Forecasting". The lively discussion period that followed showed how much those attending enjoyed their evening.

On November 13th, a panel discussion of "Gross National Product Forecast" was presented to the members of the Chapter. The speakers were Dr. D. E. Armstrong of McGill University and Economic Research, Dr. R. Dehem of the University of Montreal, and Mr. E. De Bellaigue of Greenshields. An interesting period of questions and comments followed.

On December 4th, the third meeting of the Fall period took place. It differed significantly in its form from all the previous ones. The members were provided the opportunity of visiting the premises of Adalia Computations Limited. The programme included a description of some applications of an electronic calculator to economic and statistical problems. This was illustrated by slides, followed by a

demonstration of the seasonal adjustment of a time series and a linear regression example. Adalia Computations Ltd. distributed to the members a very interesting brochure containing some programs for economists and statisticians using the Datatron 205 computer system.

New York

At the meeting of November 6th, Dr. O. K. Sagen, Director of Special Studies, National Health Survey Program, spoke on the subject, "Special Studies in the National Health Survey". Dr. Paul M. Densen and Mrs. Eve Balamuth, Division of Research and Statistics, Health Insurance Plan of Greater New York, discussed "Comparison of Morbidity Data Obtained from Household Survey and Reports of Doctors' Services in a Medical Care Plan".

The subject of the November 14th meeting was "What Every Statistician Should Know About Computers". A film, "Direct Line to Decision", produced by I.B.M., was shown. The speakers were Sam N. Alexander, Chief, Data Processing Division, National Bureau of Standards; and Richard Lewis, Remington Rand Univac Division, Sperry Rand Corporation.

On November 20th, the meeting was devoted to continuous sampling plans. Herbert Solomon of Columbia University acted as chairman. The speakers were Gerald J. Lieberman, Stanford University, whose subject was "Continuous Sampling Procedures"; and Cyrus Derman, Columbia University, who discussed "Multi-Level Continuous Sampling Plans".

"International Population and Industrial Statistics" was the topic for the December 4th meeting. Lazare Teper, Director of Research, International Ladies Garment Workers Union, was chairman. Ricardo Luna Vegas of the U. N. Statistical Office spoke on the prospective world censuses of population, and A. Aidenoff of the U. N. Statistical Office discussed the prospective world industrial censuses. A. J. Jaffe, Bureau of Applied Social Research, Columbia University, spoke on "People and Jobs in Undeveloped Areas". The discussant was M. B. Givens, New York State Committee on Low Incomes.

North Texas

At the September meeting Dan A. Brock, Analyst and Statistician for the Dallas City Water Works, spoke on "Statistical Applications in Typical Water Utility Problems". Dr. A. W. Wortham, Chief of Operations Research, Texas Instruments, Inc., reported on the Lake Murray Conference at the October meeting, and led a discussion on the topic, "What Does Management Think of Statistical Methods?" The November meeting heard Dr. John A. Ryan of Datics Corporation discuss "A Small-Scale Desk-Calculated Application of Linear Programming". In December Dr. Carl E. Marshall, Director of the Statistical Laboratory at Oklahoma State University, spoke on "The Teaching of Statistics and the Training of Statisticians for Industry."

The Chapter has elected the following officers:

President—Dr. Paul D. Minton
Vice-President—R. A. Glover
Program Chairman—Dan A. Brock
Secretary-Treasurer—Mary P. Moseley

Oklahoma City

The Oklahoma City Chapter, met on November 19th. The speaker was Mr. Lee Evans, Mathematician, Tinker Air Force Base. Mr. Evans discussed the development of Operations Research Models to measure water flows through the water distribution system of Tinker Air Force Base. Nineteen members were present.

The Chapter met on December 17th with sixteen members present. Mr. Ed F. Crim, Jr., Assistant Professor of Business Statistics, University of Oklahoma, discussed the "Philosophy and Concepts of Model Building."

Pittsburgh

At its October meeting the Chapter heard a talk by Professor Herbert Simon on "The Size Distribution of Business Firms". Dr. E. G. Bianco spoke at the November meeting on "Analyzing Life Test Data from Failure Rate Patterns".

The December meeting had as its speaker Dr. W. J. Youden. Dr. Youden's topic was, "Problems of the Experimenter".

Sacramento

Dr. Norman Rudy, Professor of Statistics and Government at Sacramento State College, was the speaker at the September 18th dinner meeting. Dr. Rudy, who recently returned from a year's leave during which he was connected with statistical programs of the Israeli Government, had as his subject "Statistical Program in Israel".

A luncheon meeting was held on October 23rd at which R. Stephen Polkinghorn, Professor of Economics at Sacramento State College, spoke on "Regional Wage Differences".

The subject of the November 20th dinner meeting was "Defining Census Tracts for Use in the 1960 Census". Miss Toshi Toki, a representative of the U. S. Census Bureau, was the speaker.

The following are the Chapter's officers for 1958:

President—H. Arthur Domonoske
Vice-President—Carl M. Frisen
Secretary—Ann C. Welch
Treasurer—David Petrocchi
Counselors—Wilbur L. Parker (Past President)
Robert H. Gustafson
William F. Hirtz
Charles E. Lundholm

Southern California

A dinner meeting was held on December 5th at which Dr. Raymond J. Jessen of the General Analysis Corporation spoke on "The National Survey of Public Health". Dr. Jessen described the sample plan and the general design of the survey.

The Chapter sponsored a joint session with the Institute of Mathematical Statistics at the latter's Western Regional Meeting, held on the U.C.L.A. campus on December 27th and 28th. The subject of the session was "Industrial Applications of Statistics". Papers were presented by Alex M. Mood, General Analysis Corporation; N. M. Peterson, Convair, Fort Worth; William C. Hoffman, The Rand Corporation; Irvine Whiteman, General Analysis Corp.; and Glen Ghormley, Cannon Electric Company. Hugh H. Brown was the ASA representative on the Program Committee for the meeting.

Twin Cities (Minn.)

A meeting of the Chapter was held December 5th in the Women's Lounge of the Coffman Memorial Union at the University of Minnesota. A brief business meeting was held during which new officers were elected. The officers for 1958 are:

President—John Neter, Associate Professor, University of Minnesota
Vice President and Program Chairman—Ray Solem, Department of Employment Security
Secretary—Gordon Johnson, Minneapolis Honeywell, Aero Division
Treasurer—Gwen Hedlund, General Mills

After the business meeting, John Neter introduced the speaker of the evening, I. Richard Savage, Associate Professor of Statistics, University of Minnesota. Dr. Savage gave a stimulating talk on nonparametric estimation.

Washington

The subject of the November 21st meeting was "Measurement of Error in Census and Surveys: Two Examples". W. Duane Evans, Bureau of Labor Statistics, chaired the meeting. The speakers were Ray Hurley, Bureau of the Census, whose topic was "Report on the Post-Enumeration Survey of the 1954 Census of Agriculture"; and Seymour Wolfbein, Bureau of Labor Statistics, who discussed "Response Errors in Current Employment Statistics". Earl Houseman, Agricultural Marketing Service and Loring Wood, Bureau of the Census, were discussants.

"Research in Problems of Military Personnel Retention" was the topic for the December 19th meeting. Harold Wool, Office of the Secretary of Defense, discussed "Recent Reenlistment Trends: Some Quantitative and Qualitative Implications"; John T. Dailey, Department of the Navy, spoke on "A Non-Attitudinal Approach to Measurement and Analysis of Career Motivation"; and Harold Dupuy, Department of the Air Force, talked on "Air Force Operational Research in Military Personnel Retention". Eli Ginzberg, Director, Conservation of Human Resources Project, Columbia University, was a discussant, and Seymour L. Wolfbein, Bureau of Labor Statistics, was Chairman.